June 1973 25p

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FIELD TRIAL AND REVIEW OF THE AKG BX20 REVERBERATION UNIT

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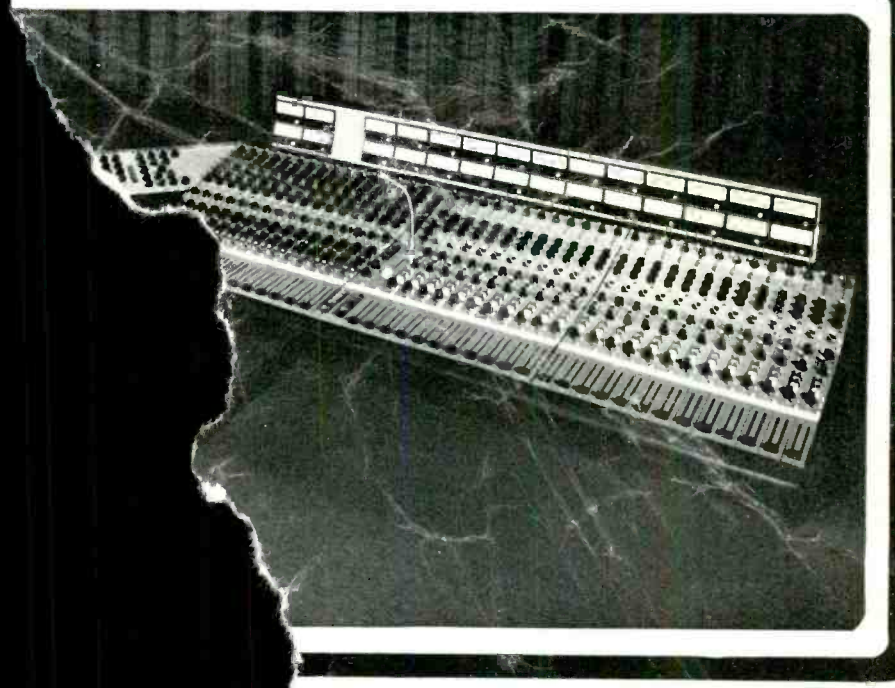

studio sound
AND BROADCAST ENGINEERING

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American Office: P.O. Box 99569, San Francisco, California, 94109, U.S.A.

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FEATURES

COLUMNS

REVIEWS

CORRESPONDENCE AND ARTICLES

All STUDIO SOUND *correspondence should be sent to the address printed on this page. Technical queries should be concise and must include a stamped addressed envelope. Matters relating to more than one department should occupy separate sheets of paper or delay will occur in replying.*

Articles or suggestions for features on all aspects of communications and musical engineering will be received sympathetically. Manuscripts should be typed or clearly handwritten and submitted with rough drawings when appropriate. We are happy to advise potential authors on matters of style.

BINDERS

Loose-leaf binders for annual volumes of STUDIO SOUND *are availabie from Modern Bookbinders, Chadwick Street, Blackburn, Lancashire. Please quote the volume number or date when ordering.*

JUNE 1973 VOLUME 15 NUMBER 6

THIS COLUMN is not often used as a vehicle for book reviews but a recent HMSO publication has so much to offer the electronic communications industry that such treatment seems justified. The publication in question is Sir Ernest Gowers's *The Complete Plain Words,** newly revised by Sir Bruce Fraser.

Copies of this eminently readable work should be on sale in the Performers' Lounge at audio and broadcasting industry conventions. Audiences might then be subjected to less of the convoluted word-mongering that so often passes for wisdom. A typical example deposited on visitors to the recent AES Rotterdam Convention ran:

'Electrical equalisation of monitor systems was examined as a means of minimising the differences between locations so that equivalent musical judgements might be made at these locations'. A grain of sense there perhaps but we fail to see the point of delivering:

'When considering the specification to which a control room should be designed, certain parameters and criteria should be considered'.

Although *Plain Words* gives many examples of verbal garbage irrelevant to this industry ('It was here that the Emperor liked to put on his grand alfresco spectacles'), others demonstrate the misuse of technical jargon at its most decadent. 'Using the indexed sequential method on an exchangeable disc, the time involved in accessing a record by searching several levels of index, and seeking index, data and overflow areas can amount to well over 200 ms. It is possible to improve upon these timings by systems optimisation.' Accessed the information level of that?

* Her Majesty's Stationery Office, £1.

SUBSCRIPTIONS

STUDIO SOUND, *published monthly, enables engineers and studio management to keep abreast of new technical and commercial developments in electronic communication. The journal is available without charge to all persons actively engaged in the sound recording, broadcasting and cinematographic industries. It is also circulated by paid subscription to manufacturing companies and individuals interested in these industries. Annual subscription rates are £3 (UK) or £3.30 ($8 or equivalent) overseas.*
STUDIO SOUND *is published on the 14th of the preceding month unless that date falls on a Sunday, when it appears on the Saturday.*

PAST ISSUES

A small number of certain past issues may still be purchased from Link House, price 31p each including postage.
Photostat copies of any STUDIO SOUND *article are available at 25p including postage.*

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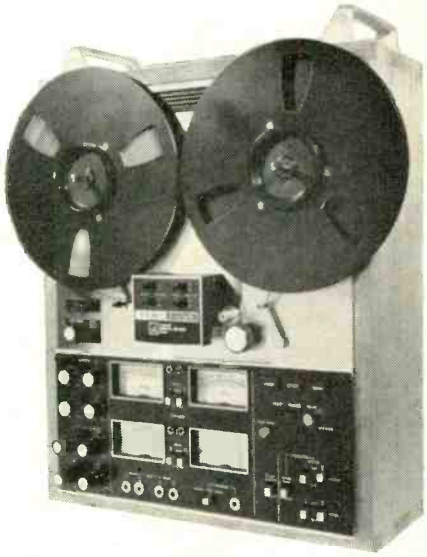

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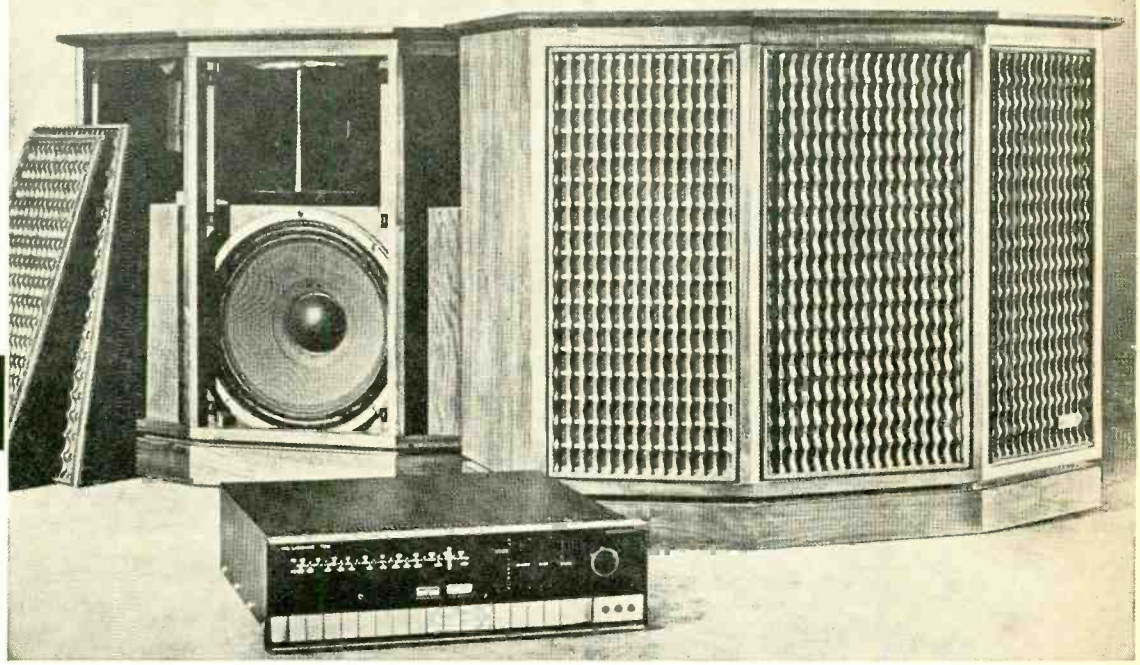
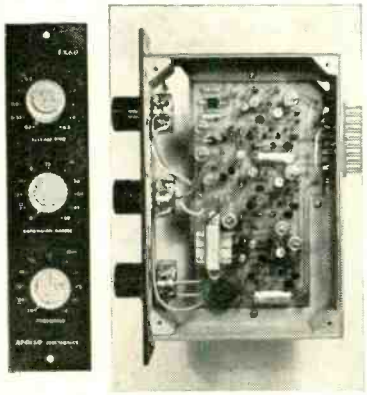


APOLLO ELECTRONICS



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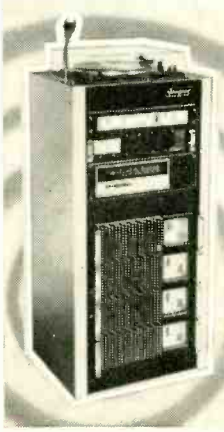

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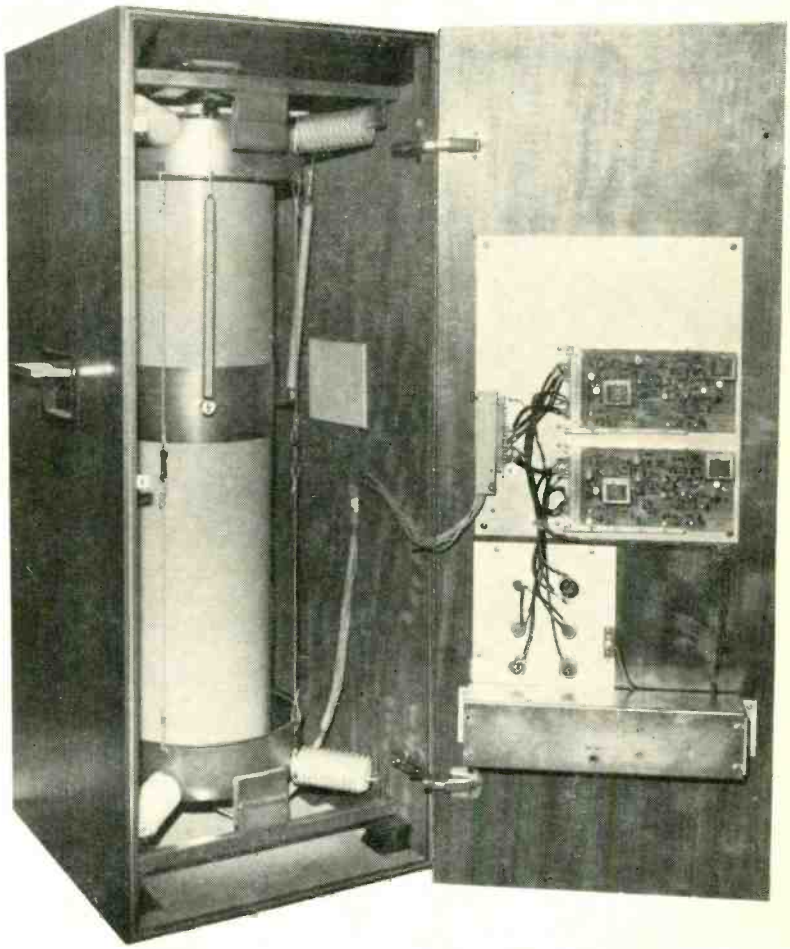

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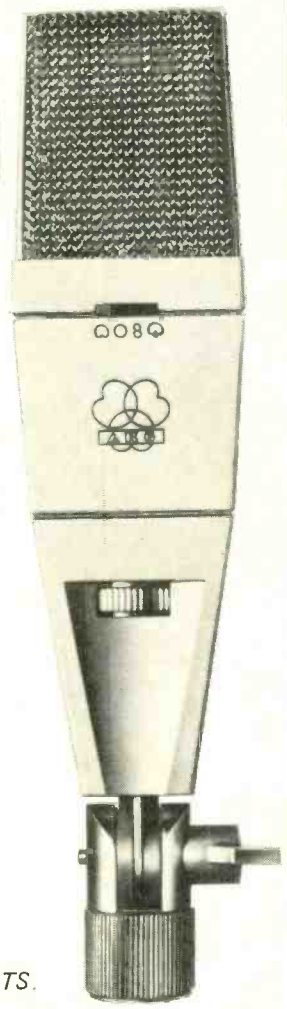

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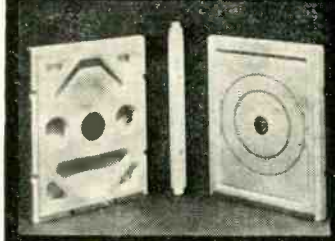

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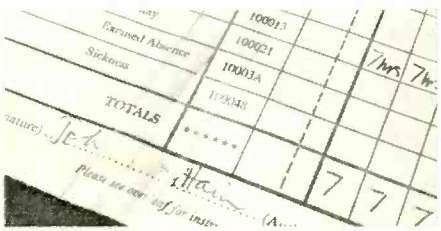
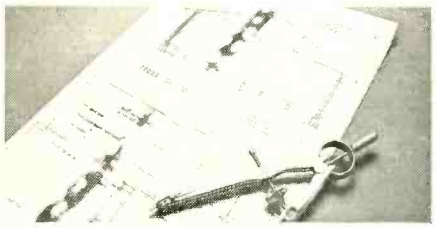
The simple case for using Scotch Magic Transparent Tape

Ordinary transparent adhesive tape

Very visible. Ordinary tape makes a very visible join and spoils the appearance of the item.



Difficult to write on. Because of its shiny surface ordinary tape is difficult to write on.

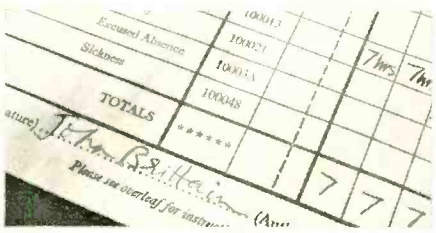


"Ghost" effect on copies. Ordinary tape gives a ghost effect on copies and photographs making the subject underneath difficult to read.

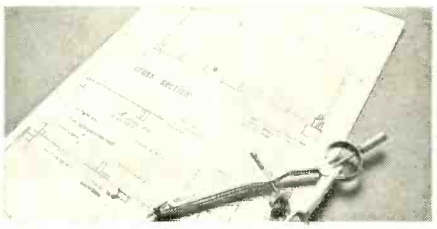
Non-permanent. Ordinary tape shrinks and yellows with age leaving an unsightly black line round the edges. It also tends to crinkle and peel off if exposed to moisture.

Scotch Magic Transparent Tape

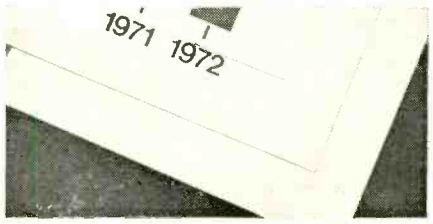
Almost invisible. Magic Transparent Tape is much less obvious. It tones in with the background so the join becomes almost impossible to spot.



Easy to write on. Magic Transparent Tape is easy to write on—ballpoint and pencil reproduce perfectly. You can type on it too.



"Ghost-free" copies. You get perfect copies with Magic Transparent Tape. The taped section is just as legible as the rest.



It's permanent—so it won't shrink, discolour or peel off. Magic Transparent Tape isn't affected by sunlight, moisture or temperature change. It stays just the way you stick it down no matter how long you leave it.

You notice the improvements. Not the tape.

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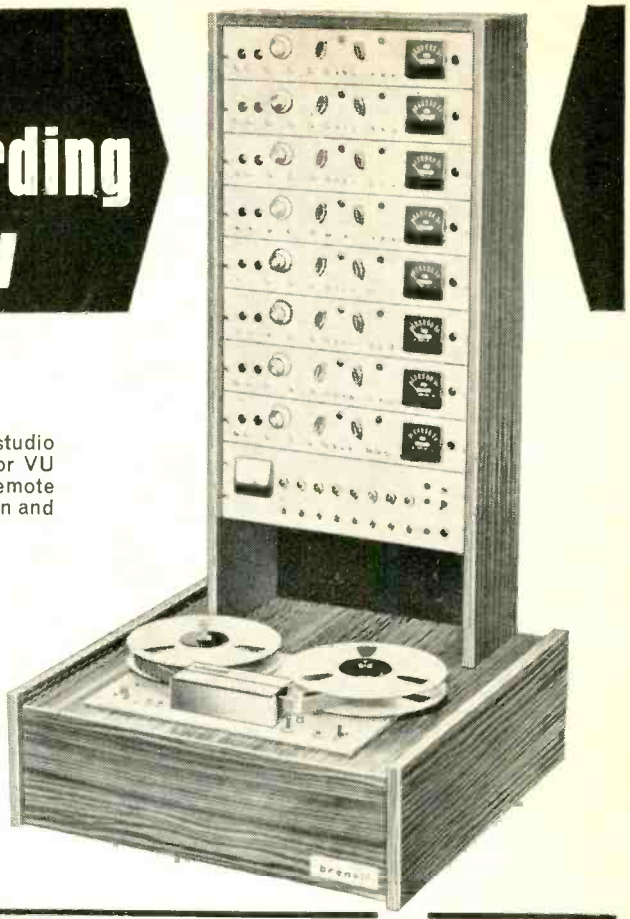

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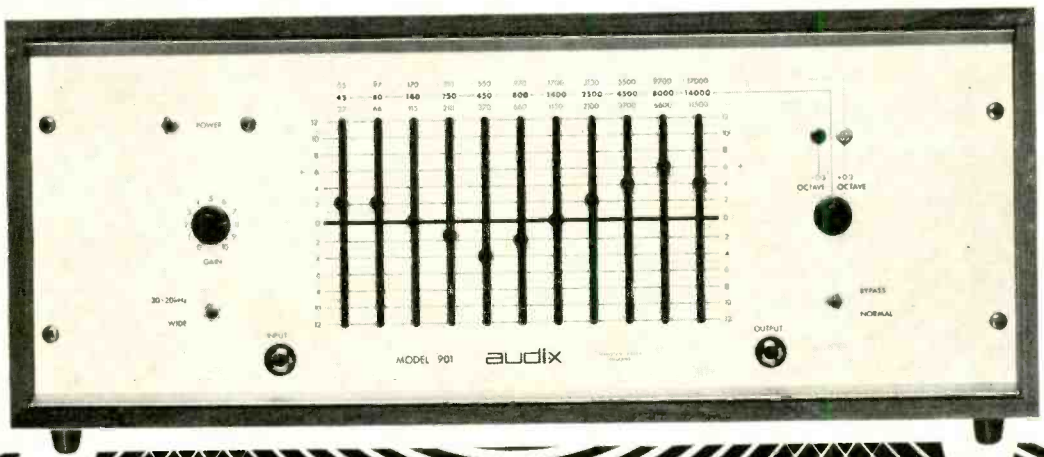

MODEL 901

The eleven frequency audio equaliser illustrated is representative of the expanding range of limiters, distribution amplifiers, monitor amplifiers, disc reproducers, etc. available from Audix for recording and broadcast studio applications.

The equaliser provides ±12db of control over an audio bandwidth of either 37–11,500Hz, 45–14,000Hz, or 55–17,000Hz on eleven logarithmically spaced frequency centres. Selection of the required bandwidth is via a control which allows the basic curve centre frequencies to be shifted up or down the audio bandwidth by 0.3 of an octave.

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NEWS

Exhibitions

THE BRITISH Kinematograph, Sound and Television Society have announced their papers programme for this year's conference and exhibition **Film '73**, to be held at the Royal Lancaster Hotel from June 25 to 29. Among the papers will be a survey of the state of the art; image quality; electronic reproduction of film; education and training; studio lighting methods; film versus tape; sound recording/reproduction; and new film equipment. Registration fee for the conference will be £8 for society members and £2 for retired members and retired fellows of the society.

The 1974 **International Broadcasting Convention** will be held at the Grosvenor House Hotel, Park Lane, London, from September 23 through 27. Papers will be presented on automation in broadcasting; training and management; future maintenance philosophy; propagation and service planning; receivers; recording, storage and replay; satellites in broadcasting; training and management; signal distribution systems; signal sources; stereophonic and quadraphonic sound systems technical aspects of international programme exchange; and transmitters, transposers and aerials.

The **London Electronic Components Show** will be held at Olympia between May 22 and 25. Among the exhibits will be the Apollo Ten space capsule, which is being borrowed from Nasa for the week, along with samples of moon rock and a descent parachute. The exhibitors include Hamlin Electronics, makers of reed switches, AEI Semiconductors, Electrographic Peripherals (high speed tape readers and winders), Penny & Giles, Hatfield Instruments (radiotelephones), AB Electronic Components, Wolsey Electronics (aerials and amplifier systems), Semiconductor Specialists (Gallium Arsenide displays and other indicators), Advance Electronics, Multicore Solders, Enthoven Solders, Cherry Electrical Products (microswitches), Honeywell (switches and meters), J-Beam Engineering (aerial rotators), Hysol Stirling (encapsulation materials), Spear Engineering (component connectors), Miles Platts (transformer bobbins), and BICC (cables and wires).

Audio Visual Trade sessions at this year's **Internavex** exhibition will include stereoscopic colour television projection. The registration fee for July 16 will include admission to all the trade sessions and a buffet lunch, admittance to Internavex '73, associate membership of the Audio Visual Association, and an AVA dinner. The exhibition will be held from July 17 to 20. Admission to the trade sessions on July 16 will be by invitation only. Full details are available from The Audio Visual Association, 33 Queen Anne Street, London W1M 0AL.

Emi buy Simms Watts

EMI HAVE acquired public address engineers Simms Watts. The company were bought by EMI's £11,000,000 Sound and Vision Equipment subsidiary. Simms Watts, formed in 1968, produce a range of amplifiers giving up to 200W singly, or building up to 2 kW in stacks. They also act as agents for foreign equipment, including RCF of Italy. Simms Watts have one subsidiary in musical instruments: Rosetti & Company. EMI are presently engaged in developing their chain of cinemas and entertainment centres and the acquisition of Simms Watts is a further step in this direction.

AEG concession

ALL AEG products are now being handled in Britain by Hayden Laboratories, Hayden House, 17 Chesham Road, Amersham, Buckinghamshire.

New President for APRS

SIR GEORG SOLTI has been appointed president of the Association of Professional Recording Studios. Mr Arthur Haddy, a director of Decca Records, will remain as vice-president. Announcing these appointments, the secretary of the Association also appealed for odd lengths of 6.25 mm tape, which studios may wish to discard, to be donated to blind studios at the Bodleian Library of Oxford University. This should be sent to Mr H. Snider c/o the Blind Students Reading Room at the Bodleian Library. Mr Masek further announced that arrangements had been made with Ferrograph to supply their tape machines at a ten per cent discount to members of the APRS. The money should not be sent to the APRS, payment being settled direct with Ferrograph.

Emipeople

SEVERAL NEW appointments at Emitape. In charge of commercial management and professional products will be Mr Ted Naef and the consumer side will be controlled by Mr Terry Herbert, formerly the national sales manager. Mr Jim Fenton is the new manager for marketing services and manager of UK sales is Mr Peter Sollitt, formerly UK field sales manager.

APAE President

NEW PRESIDENT of the Association of Public Address Engineers is John Robins of SNS Communications. Mr Robins joined SNS as marketing director in 1966. In 1962 he had started his career as a salesman for Derritron and had become sales manager there within a year. Keith Monks is the president-elect, John Davies stays as honorary secretary, and John Weed as honorary treasurer.

The APAE have now formed a subsidiary, APAE Promotions Ltd, to handle sales, publishing, exhibitions and meetings. The directors are John Davies, Keith Monks, Eric Sawkins, R. A. Walker and John Weed.

A Section of the 16 Input sound console installed by Cryslon Electronics at the Alexandra Theatre, Birmingham. Four output groups are provided plus two master auxiliary output channels. Further information: Cryslon Electronics Ltd, The Firs, Rother Street, Stratford-on-Avon.

Take a QUAD 50E Amplifier (a good start for any installation)

plug it into your monitor system and it bridges 600Ω lines to drive your speakers.

Take that same amplifier and, without changing it in any way, plug it into another installation to deliver 50 watts into 100 volt line * from a 0.5 volt unbalanced source. This versatility and its attendant easing of stocking and maintenance problems is one reason why large organisations use the Quad 50E.

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Excellent power and frequency response (—1dB).

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Pre-set level control adjustable from front panel.

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Small size ($4\frac{3}{4}$" x $6\frac{1}{4}$" x $12\frac{3}{4}$")— (120 mm x 159 mm x 324 mm).

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PATENTS

THE FOLLOWING list of Complete Specifications Accepted is quoted from the March weekly issues of the Official Journal (Patents). Copies of specifications may be purchased at 25p each from The Patent Office, Orpington, Kent BR5 3RD.

March 7, 1973

1313608
Western Electric Co Inc
Optical modulators

1313667
Licentia Patent - Verwaltungs - GmbH
Scanning circuit arrangements

1313676
Yokowo Mfg Co Ltd
Radio aerials

1313707
Tektronix Inc
Oscilloscope signal sampling method and system

1313771
Ampex Corporation
Intelligence transducing beam modulation method and apparatus

1313778
Marconi Co Ltd
Electromechanical transducers

1313832
British Broadcasting Corporation
Reduction of errors in television signals

1313836
Debell, L. R. and Price, D. D.
Apparatus for playback of plural track records

1313858
Marconi Co Ltd
Position resolving apparatus

1313882
Eastman Kodak Co
Cinematographic cameras

1313936
Marconi Co Ltd
Capacitive transducers

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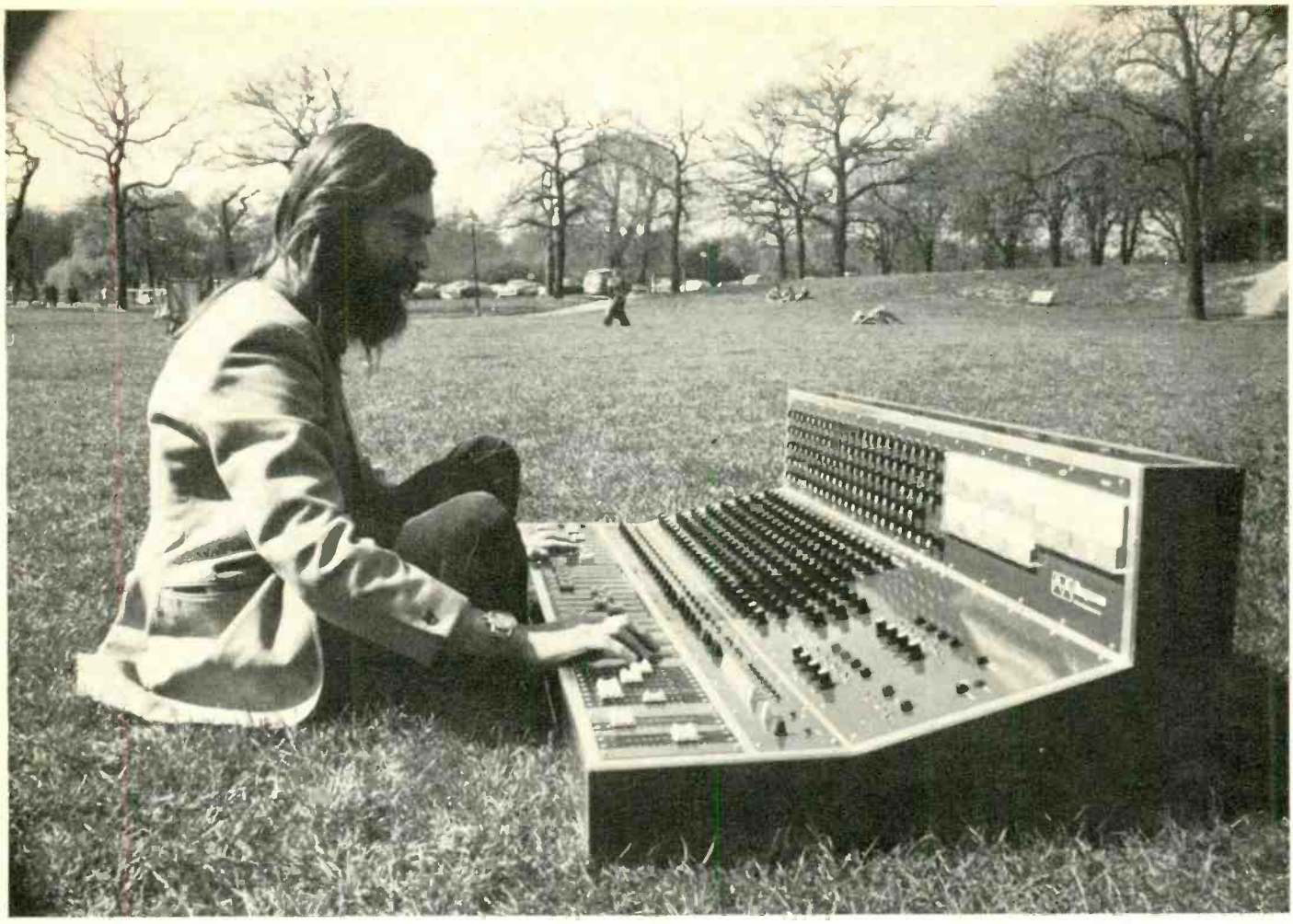

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PATENTS

Continuous loops

CONTINUOUS LOOPS can be of the coil or the random storage bin type. NRDC in BP 1,296,854 suggest an interesting new approach to using a loop of the single coil type which should overcome some of the problems inherent in pulling off tape from the centre of a coil. Two rollers (*4, 5* in **fig. 1**) are mounted on vertical spindles *2* and *3* spaced apart on a base member *1*. Rollers *4* and *5* accommodate a flat coil of tape *6* and a cover plate *7* is mounted over the coil to keep it in place. The invention proper is a pair of thick cylindrical guide posts (*9* and *10*) which project upwards from the base; but whereas guide *10* stands vertically, guide *9* is inclined towards post *10*. Deflector *8* serves to prevent the tape from bunching.

The tape forming the inner convolution of the coil leaves roller *4* and wraps once around guide *9* (**fig. 2**). The guidepost is so positioned

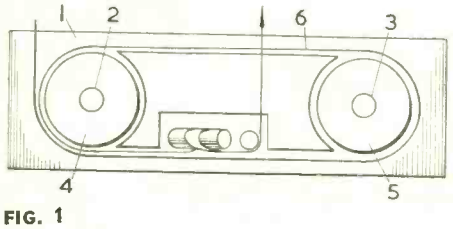

FIG. 1

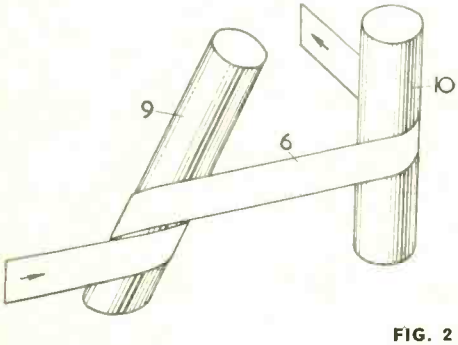

FIG. 2

and inclined that the tape is not twisted as it passes from the roller to the post. As the tape passes round the inclined post *9*, it takes a helical path slightly in excess of one width of the tape and is thereafter able to leave the guidepost *9* travelling in a horizontal direction but sufficiently elevated as to be above the top level of the tape coil. The tape then passes through a right angle around post *10* and travels off to the tape machine from whence it is fed back to coil *6*. If the spacing of posts *9* and *10* and the inclination of *9* are carefully arranged, the tape will be withdrawn from the inside of the storage coil with uniform tension across its whole width. The patent also shows how a pair of inclined posts can be used as tape guides. The general idea seems applicable to video and audio tape recorders, as well as to film projectors. On paper at least, it looks a simple but workable answer to a perennial problem. **A.H.**

Instant movie film

IT SEEMS THAT the Polaroid Corporation have their sights set at launching instant development movie film on the world market. BP 1,299,991 refers to various British and American patents on the chemistry of developing monochrome and colour film automatically, in the manner of the instant still system. The present patent is concerned mostly with a cassette which looks outwardly rather like a conventional *Super 8* cassette and can be used to put such chemical theory into practice.

The cassette has the usual supply and take-up spool for photosensitive film and, to shoot this film, it is driven by a camera claw mechanism past an optical arrangement in the cassette which includes a prism with one face grooved in the manner of a film gate.

The prism arrangement lies along one side of the cassette. Along an adjacent side is arranged a quite separate film gate or applicator box through which the film also runs. This box is connected via a tube and nozzle to a two-part storage system for developer. The first part of the developer store is a flat plastic bag and the second part a rather smaller bag which is flattened under pressure by a block of foam. The developer is initially stored in the first bag but this can be ruptured along a pre-weakened line to allow the developer to exude into the second bag and from there under pressure down the tube and via the nozzle into the applicator box.

When the film is shot, the developer remains securely in the bag and various locating pins in the camera hold the film away from doctor blades in the applicator box. After shooting, the cassette is removed from the camera and placed in a projector. The developer is released by an operator pulling a knob which drags a string of toothlike members across the first bag to rupture its pre-weakened seal. More registration pins ensure that the film is now held close to the doctor blades in the applicator box when the projector is run to pull the film back through the cassette in contact with the developer which is now being fed to the applicator box. The doctor blades ensure that the developer is wiped evenly over the film before it is rolled up on the take-up spool. The film is now made to be in fit state to project by running it again through the projector and shining light from a projector lamp into the prismatic gate. Thus the film never leaves the cassette during shooting, development or projection. And what will it cost? **A.H.**

Talking through ears

STC IN BP 1,297,093 describe an interesting new type of headphone which functions as a microphone. A hard polyurethane shell *10* (**fig. 3**) is filled with foam *12* held in place by another inner shell *13*. This, together with a sealing cushion ring *11*, forms an airtight cavity when pressed over the ear of a wearer. A pressure gradient microphone capsule *30* is mounted in the middle of a sheet of nylon crepe *14* strung across the inside of the shell. The sheet 14 is acoustically transparent and is capable of distorting uniformly in all directions. When the wearer speaks, sound energy from his mouth and nasal cavities are transmitted through his head into the ear canal and set *14* vibrating. The microphone itself is piezo electric.

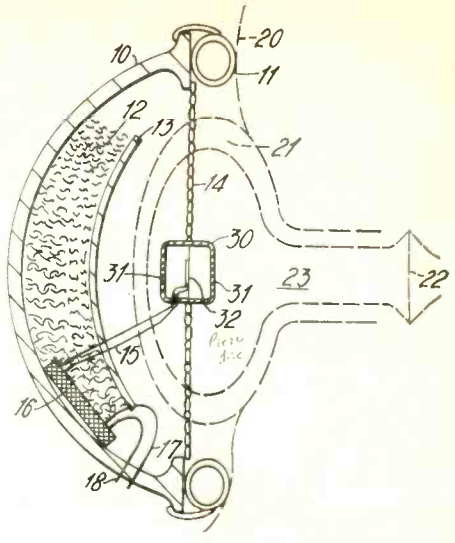

FIG. 3

The advantages are to the wearer's hand and mouth, which are left free, and the microphone is totally shielded from ambient noise. This could make it very useful for studio communication and outside broadcasts. The arrangement produces a bass-heavy signal, of course, but this is evened out in an external equaliser. **A.H.**

Economical speech communication

IN BP 1,296,034, the Post Office describe techniques for cramming several speech communication systems into channels of limited bandwidth. The invention arises from observations that treble speech crosstalk is in practice less distracting than that due to bass components. Above 500 Hz, the energy of speech waves falls as their frequency increases. Thus, in the Post Office system, treble frequencies between 1 kHz and 3.5 kHz are transmitted in a common band but the bass frequencies are omitted from this band. Although division between treble and bass is chosen to be at 1 kHz, this is not regarded as a necessarily fixed parameter.

Briefly, the various channels to be transmitted are grouped in pairs with carriers of different frequencies such that the frequency components in a pair of channels for a given band of treble speech frequencies occupy a common frequency band. In this band, the components of one channel are inverted in frequency relative to components in the other channel.

Details are given of an example circuit having one erect channel and one inverted channel (with top cut at 3 kHz and amplitude of a 4 kHz carrier). Both feed a low pass filter of which the output consists of speech waveforms from 300 Hz to 4 kHz of the erect channel and from 300 Hz to 3 kHz of the inverted channel which appear as frequencies 3.7 Hz to 1 kHz. These signals are used to modulate an rf carrier. Details are also quoted of separate reception channels, in one of which there is frequency inversion and in both of which filters prevent the taboo speech energy below 1 kHz from reaching the loudspeaker. The system could presumably find fairly extensive use in studio speech communication networks. **A.H.**

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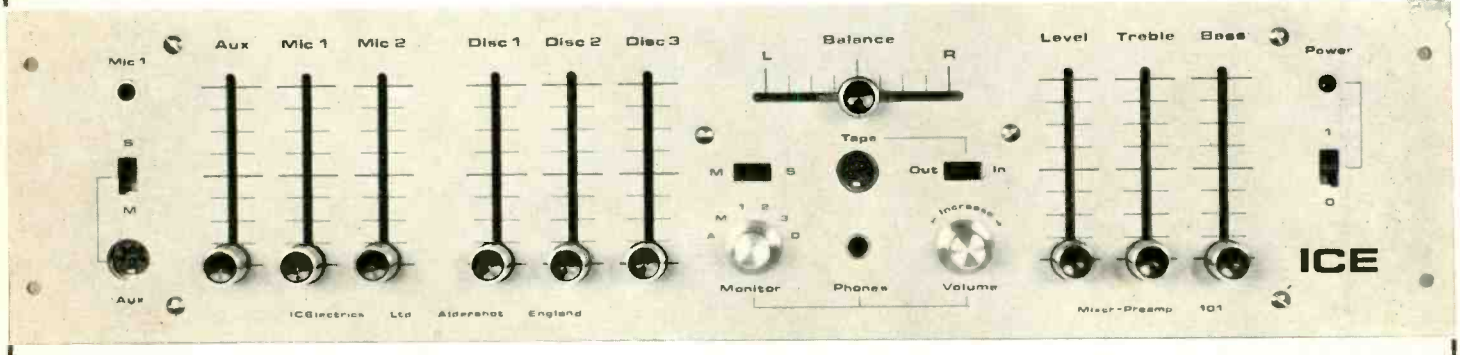

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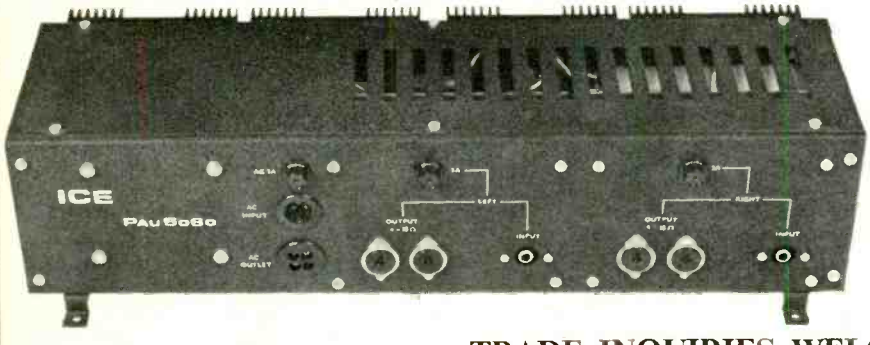

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AES Rotterdam

JOHN DWYER

A report from the 44th Audio Engineering Society Convention

THE 44TH AES Convention was held in Rotterdam between February 20 and 22. The first European AES convention had taken place in Cologne in 1971, and the second was held in Munich last year.

The Rotterdam convention attracted over 500 visitors to see the exhibition and hear over 40 speakers from Austria, Belgium, Bulgaria, Czechoslovakia, Denmark, Finland, France, West Germany, German Democratic Republic, Great Britain, Italy, Hungary, the Netherlands, Norway, Poland, Rumania, Switzerland, the USA and Japan.

At the convention banquet in the Golden Ballroom of the nearby Hilton Hotel, AES members washed *Le Jambon des Ardennes au Melon* down with vin blanc, followed it by *Le Fumet de Queue de Boeuf* and *Les Paillettes Dorees*, after which they used vin rouge to oil the throat while they munched through *Les Medaillons de Veau Princesse*, *Les pommes croquettes*, and *La bouquetiere de Legumes*. *La bombe tricolore* and coffee finished the proceedings.

If they were still awake they could watch awards of Fellowship of the AES being conferred on Peter Burkowitz, Chairman of the Central European section of the AES and group recording manager for both Polydor and Phonogram International, for 'continuous contributions to the art and quality of sound recording and recording instrumentation'; on Arthur Haddy of the Decca Record Company for 'four decades of fruitful service to the phonographic arts'; and on Edmund Mortimer of Garrard for 'a career of contribution to the technology of automatic record players'. The awards were presented by the president of the AES in New York, Hugh Allen.

During the convention, visits were arranged to the technical and physical department of Delft University and the acoustical institute; to EMI's studios at Heemstede, just outside Rotterdam; to the studios of the Dutch Broadcasting Corporation at Hilversum; to the institute of sonology at Utrecht university; to Andre van de Water's studios at Baarn, recently covered in STUDIO SOUND; and to St Laurens church in Rotterdam, where visitors could see the building of a new organ.

There were 32 stands at the attendant exhibition: Beyer, Thorens, Studer, Tonographie, Philips Netherland, NTP, Shure, Nortronic, Kongsberg, Emitape, Dolby, AEG Telefunken, Bozak, Altec Lansing, Feldon, Neumann, General Radio, Schoeps, AEG Milano, EMT, Electrovoice, Knick, Helios, Neve, Sennheiser, Woelke, B&K, Ortofon, Italtel, Leonhard, Stellavox, AKG.

In his opening address on the Tuesday morning, Peter Burkowitz, the chairman of the European section of the AES, said: 'Our fascinating business still has a very good growth potential which we all together can further enhance by building up in Europe a large and meaningful community of skilled practicians, experts and scientists in the combined fields of electroacoustics and allied disciplines'. Referring to his opening address in Munich the previous year, Mr Burkowitz reminded the audience that it was one of the particular advantages of the audio profession that they were confronted not only by mechanisms, formulae and efficiency calculations but also by an infinite variety of human and artistic facets. 'Even those engineers who might not directly feel this involvement when designing the framework for a new amplifier may realise that it is the transport of emotions to the ear of the listener, which this part is intended to carry forward later on, that really makes this design viable.'

He noted that audio engineering had become much more complex and refined in the last few years and the engineering devices themselves had become big business. 'The audio psychologists and advertisers make it their task to motivate the refinements and enhance the demand.' He said that this presented a 'wonderful opportunity' for the serious and ambitious audio engineer and for those assembled at the convention.

There were 43 lectures in the programme, of which 30 were in English, four were in French and nine were in German. These were split into six sessions, two on each day: studio techniques; sound analysis and synthesis; listening and perception; sound reinforcement and radiation; sound recording; audio measurements; quadraphony; and audio instrumentation. There were also two forums: music and environment, which dealt with listening domestic conditions and the influence of music on human beings; and studio operations, which considered recording and processing, studio efficiency and multitrack recording.

There was obviously too much going on at

24▶

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the convention for a lone reporter to keep track of all that was said, but I will give outlines of some of those lectures it was possible to attend which might be of interest to readers of STUDIO SOUND.

The second lecture in the first session was given by Edward Veale of Acoustic Consultants in Hertfordshire. It was called 'The Environmental Design of a Studio Control Room', and dealt with the acoustics of the sound control room.

Mr Veale began his lecture by saying that the control room was quite different to any other room in which sound was listened to and so deserved to be considered in its own right, not in relationship to any other room. 'It has been the practice of some acoustical engineers to design the acoustic environment of a control room to emulate or approximate that of a domestic listening room. This practice is not necessarily correct as no two domestic listening rooms have the same acoustic environment . . . A further consideration in this context is the fact that the majority of domestic listening rooms have some acoustic deficiency which may be either complimentary or detrimental to the texture of the sound reproduced in that room'.

He went on to describe those aspects of the mechanics of hearing which he thought would affect control room acoustics and would determine which acoustic materials were used. Then he said that when considering what these materials would be the objective should be to produce an inert room: 'In this respect it can be stated that all acoustic materials employed for the treatment of a control room should be of the passive variety and not of the active variety . . . It is undesirable to employ any acoustic material which will introduce an addition or a non-linear modification to the sound within that room'. No addition or subtraction must be made by the room to the sound made by the monitor speakers.

He continued that room acoustics could be measured in terms of reflection patterns with the equipment now available. Reflections reaching the ear between 10 and 70 ms after the original sound help to interpret and construct a complete picture of the sound on the one hand, without creating room ambience and introducing coloration to the created sound picture on the other.

Further, if too few reflections were present in the control room the sound heard under domestic conditions sounded lacking in reverberation content. If too many reflections were present the reverberation content tended to be excessive. Between four and seven reflections were required by the ear of the engineer to achieve satisfaction.

'We have also established that the first reflection is required to arrive at the ear of the listener at between 10 and 15 ms after the original sound and that the amplitude of this first reflection should be between 4 and 6 dB lower than the original sound. The remaining reflections should be reasonably evenly spaced along the time scale up to a point of between 50 and 70 ms after the original sound. Each of the subsequent reflections should be diminished by between 4 and 10 dB when compared with the previous reflection.' Mr Veale then described in general terms what he considered the best way of achieving these results in a practical situation.

The next lecture was by John Eargle of Altec, whose lecture was called 'A Survey of Studio Monitoring Problems'. He said that it was difficult to make an acoustically perfect control room look good as well, or, as he put it, 'many of the aesthetic demands of the monitoring environment are antithetical to the acoustic demands of good listening'.

Continuing in much the same way, he said that control rooms were often too small for good low-frequency propagation, that the engineer and producer often wanted to be in the centre of the room surrounded by equipment, which didn't help, and that loudspeakers hung from the ceiling also caused problems.

Creative environment

The creative environment had to be intimate, which involved lots of carpets and absorbent wall-coverings. Producers also wanted to be in the direct field of the speakers and to hear no reverberations from the room itself in order to hear the ambience they had put on the recording. 'This calls for considerable amounts of high frequency absorbers as well as fairly resilient boundary structures [walls] at mid and low frequencies.' This was essential even though sound might escape into neighbouring rooms.

Adequate baffling of the loudspeakers would help, together with sensible, non-reflective surrounds to them. In smaller rooms, electrical equalisation would be needed to counteract the deficiencies in the control room's acoustics, though it has limits. We don't have to make the room flat but we should know what it's doing and make it fairly consistent.'

Mr Eargle then gave a mathematical analysis of the Q factors of suitable radiators, where Q was defined as 'the ratio of the sound energy at some distance along a specified axis for a given radiator [loudspeaker] compared with an isotropic, omnidirectional radiator of the same efficiency along an axis of the same length'.

The sixth lecture on Tuesday morning was given by Mr S. Steinbach of the Hungarian Radio and Television service, who described his experiments on the balance of listening levels in two and four channel systems. He said that lack of good balance upset sound perspective and caused poor reproduction of stable and moving sound sources.

Irregular sound field

'In the pure electrical part of the chain there is no problem in making the difference as little as is necessary. But the sound field of loudspeakers is very irregular even if the individual equipment has a smooth frequency response measurement in an anechoic chamber. It is not sufficient to assure an approximately equal sound pressure level at the place of the sound engineer.'

His experiments comprised moving a sound around four speakers and giving volunteers a 'pointer' loudspeaker with which to compare where they thought the sound was coming in two or four channel with the location of its virtual image.

The most stable images proved to be in front, as one might expect. In the case of the rear pair of speakers the virtual sound source is shifted to the left. The greatest uncertainty was at the two sides; presumably our hearing has developed this way because we can easily turn our heads round to put these side sounds to the front. 'It doesn't mean that this region is to be given up. If one uses a four channel stereo system not only for a better ambience but for reproduction of moving sources a careful balancing procedure is needed.'

Mr Steinbach's results would seem to deal a body blow to most of the 4-2-4 four channel matrix systems.

The next paper, by Jan Melis and Bauke Nijholt of Phonogram International, described the low frequency response of multitrack recorders. Mr Melis, who delivered the paper, said that full tape width recorded test tapes would introduce errors at low frequencies due to the fringing effect. The amount of error would depend on track configuration as well as on head properties. Ampex had issued eight and 16 track test tapes with separately recorded tracks to avoid this but the manufacture would be costly because all the tracks had to be calibrated separately.

The paper described a means of measuring the necessary corrections to make when using full width recorded test tapes, bearing in mind that a method of calculating the fringing deviations has appeared in the AES Journal.

After describing his method, which involved

making a full track recording at constant record head current and using a special five track erase head to obtain four separate tracks, Mr Melis said: 'The deviations due to fringing do not keep on growing towards lower frequencies. For typical multitrack reproduce heads the necessary corrections remain therefore well within 2 dB, when considering 38 cm/s tape speed and a bandwidth down to 30 Hz while using such full track test tapes.'

Last year we described Herman Wilms's lecture on the 'Ambiguous dBm' as the most entertaining performance of the convention. This year the same could be said of John Bowsher's lecture on 'The Ambiguous Watt'. Mr Bowsher was mainly interested in finding, and settling on, a means of specifying the output power of an amplifier.

Somewhat facetiously, Mr Bowsher went through all the various forms of power rating that had appeared in the literature of various companies and in the pages of magazines, including this one. He concluded that most of these various terms were meaningless, including the infamous 'watts rms' which he calculated according to the usual methods and said that the ratio between peak power and rms power was 1.632993, 'which is useless to anyone,' he said. The same also applied to the ratio of rms power over average power.

He concluded by saying that an amplifier ought to be rated according to the 'peak output voltage it can supply, because the ear is very sensitive to peak clipping'. We look forward to reporting on the considerable amount of interest which this paper is bound to arouse.

On quadraphony

The session on quadraphony was well-attended, though I doubt whether any of the audience were any the wiser when it had finished than previously. I had been told to expect fireworks by someone I was speaking to the night before but, as far as I could judge, the whole subject bored everyone stiff; even those who presented papers seemed to wear a weary 'God - I - wish - I'd - never - started - this' expression.

Ben Bauer brooded in a corner away from the main speakers' and the chairman's seats on the front row. He did not applaud. Nevertheless, Bauer and John Mosely spoke civilly to one another during the question time of Bauer's lecture, and were even bending over backwards to agree with one another, a sure sign that past squabbles have been patched over.

This alone would seem to indicate that the four channel boys have realised that their problem is not to convince one another that what they have is the best system, but that they are all going to be hard put to it to convince the rest of us that any of the systems are either good or necessary at all. Enough said.

The convention was a great success. The facilities were little short of perfect, especially as regards audio visuals. A number of television monitors around the Doelen hall, where the convention was held, flashed announcements on to their screens to let those in and out of lectures know what was going on. On the other hand, the floors were hard to walk on after a while and one had to walk out of the building and along the street if one wanted any other refreshments than coffee. About the Doelen music and congress centre itself there is little to say. It has underground parking for 850 cars, three concert halls, any number of reception areas, cloakrooms and offices, five conference rooms of which the largest holds 200 people, a ballroom and an orchestra library, to name but some of what's in the complex's 165,000 m^3.

Now the above information is not wholly gratuitous padding. The next AES convention will be held in Copenhagen and in 1975 the convention will probably be held in London. Personally, I am hard put to think of a single place in or near London that an organisation such as the AES could take over for three days which has half the facilities of the Doelen in Rotterdam?

The likelihood is that the convention will be held somewhere outside London. Cambridge has been suggested. I put the problem to the AES chairman, Peter Burkowitz, who was too polite and diplomatic to admit that there might be a problem at all. 'All we are worried about in doing a convention of this kind is that the standard of the papers keeps on rising as it has, and I know that when we get to London that will be no problem at all,' he said. He may not be worried, but I am.

BBC RADIO BLACKBURN

By Douglas Oakley

RADIO BLACKBURN are situated at King Street, Blackburn, the building itself being a converted car showroom. I was shown around the station by Bernard Shields, the station engineer.

Radio Blackburn commenced transmission in December 1970, a month before schedule because of the need to warn people of impending power cuts. They were able to begin prematurely because Bernard, having assisted in the installation and running of Radio Merseyside for three years previous, had decided to commence installation of the simplest studio first. He started this task in September 1970 so that operations staff could train on this studio while he finished off installation of the more complex main studio, studio One. As it transpired, studio Two began transmissions as soon as it was completed, studio One being completed between power cuts.

Studio One is a typical local radio studio. The studio desk is identical to the control room desk so that the studio can operate independently of its control room when the need arises. In fact, most programs are controlled from the studio desk.

The desk is a Pye *8500* series with 11 channels. Each channel has a prefade system so you can see the prefade level on the meter if you press the prefade key and select prefade on the auxiliary ppm. The prefade gain can be adjusted until the level peaks six on the ppm for speech peaks and, when the fader is fully opened, the level just set up appears on the air.

Any channel of the 11 can go via *AM6/7* compressor/limiter amplifiers and the group switch to the main modules. There is an *AM6/7* for each of the two groups, also a voice-over unit. The compressors have a threshold noise gate level. On the group controls you cannot fade down completely, only reduce or increase the level. Channel seven is an independent channel which goes direct to the main module.

Stereo conversion

The *8500* incorporates two output modules which are switchable to the output of group One, group Two or both, with space for a stereo ppm. The whole of the system is prepared for stereo conversion. There are two A and B feeds to the fm transmitter, all the stereo routing is wired, and all it needs is a mono/stereo switch. The channels can be converted to stereo by unplugging the mono units and fitting stereo channels in the same sockets. There is room in the transcription decks for a second BBC amplifier. Stereo amplifiers would be needed for the Studer tape recorders. The few complete stereo tape machines are used purely as half track mono.

However, it looks as though expansion to stereo is not going to happen, at least for the present, because priority has been given to medium wave for local radio. The idea is to give a service to people without fm sets and to those with am car radios.

The compressor/limiters are used only as limiters on vhf program material, compression being restricted to instances such as on the telephone feed to 'Phone Forum' (listener participation) to try and cut down the background noise, the compressor having a noise gate as well. The voice-over facility is mainly intended for dj programs.

The program level must be carefully set by means of the prefade system since, due to its position in the chain, the limiter cannot prevent overload distortion in the desk itself. This aspect of limiting is a common cause of misunderstanding. A battery-powered Grampian spring reverberation unit is kept in studio Two, where most of the live music recordings are done, but is capable of being plugged up to studio One from the operations bay.

Unlike normal BBC Radio practice, there is no central control room through which all incoming network programs are routed. Routing is done by means of rbs buttons on the desk. The appropriate network signal, once selected, is routed through channel Eight on the desk. Radios One, Two, Three and Four are available, the latter three being received by Armstrong *524* fm tuners. Radio One arrives by landline. A fifth button connects to an Armstrong *523* am/fm tuner to act as a standby. It has been used on occasions to route Radio Two from long wave during an emergency.

Radio Blackburn also have a radio car used for outside transmissions to the studio. Signals from the car are picked up by a uhf aerial 2 km away, which can be rotated remotely by means of a switch on the desk. In the car itself is a two channel mixer, similar to that in studio Three, which is operated by the announcer/driver. There is an fm circuit for talkback cueing purposes, also they can be cued by 'off air' checks. The car has a transmission range of up to 50 km, depending on the particular location. For playing excerpts into programs, there are six Studer *A62*, mechanically noisy but good machines, and Plessey *CT80* cartridge machines with record and replay facilities. All jingles are recorded at the studios.

Thorens *TD124/11* disc reproducers are used for gram, quick started by means of a felt pad. A clutch mechanism is incorporated but this is used mainly as a standby. Using the felt mat, a disc can be cued in under 2 cm run-up, whereas the clutch requires about 15 cm.

Microphones used are AKG *D202* for announcers, djs and news; an STC *4038* ribbon for talks, and a Calrec capacitor for discussions. Other equipment includes STC *4049* headphones (standard BBC issue). Monitor speakers are KEF *Concorde* driven by HH Electronics *AM12* power amplifiers. There are also several Ferrograph tape machines and a Chilton *100* for editing purposes.

For outside broadcast use there is a Pye desk, plus two Shure mixers used as groups, an Audix amplifier, and various column loudspeakers. Uher *4000L* and Nagra battery tape recorders are employed.

The studios themselves are all BBC London design and were built to normal talks studio specification. The final acoustics were sorted

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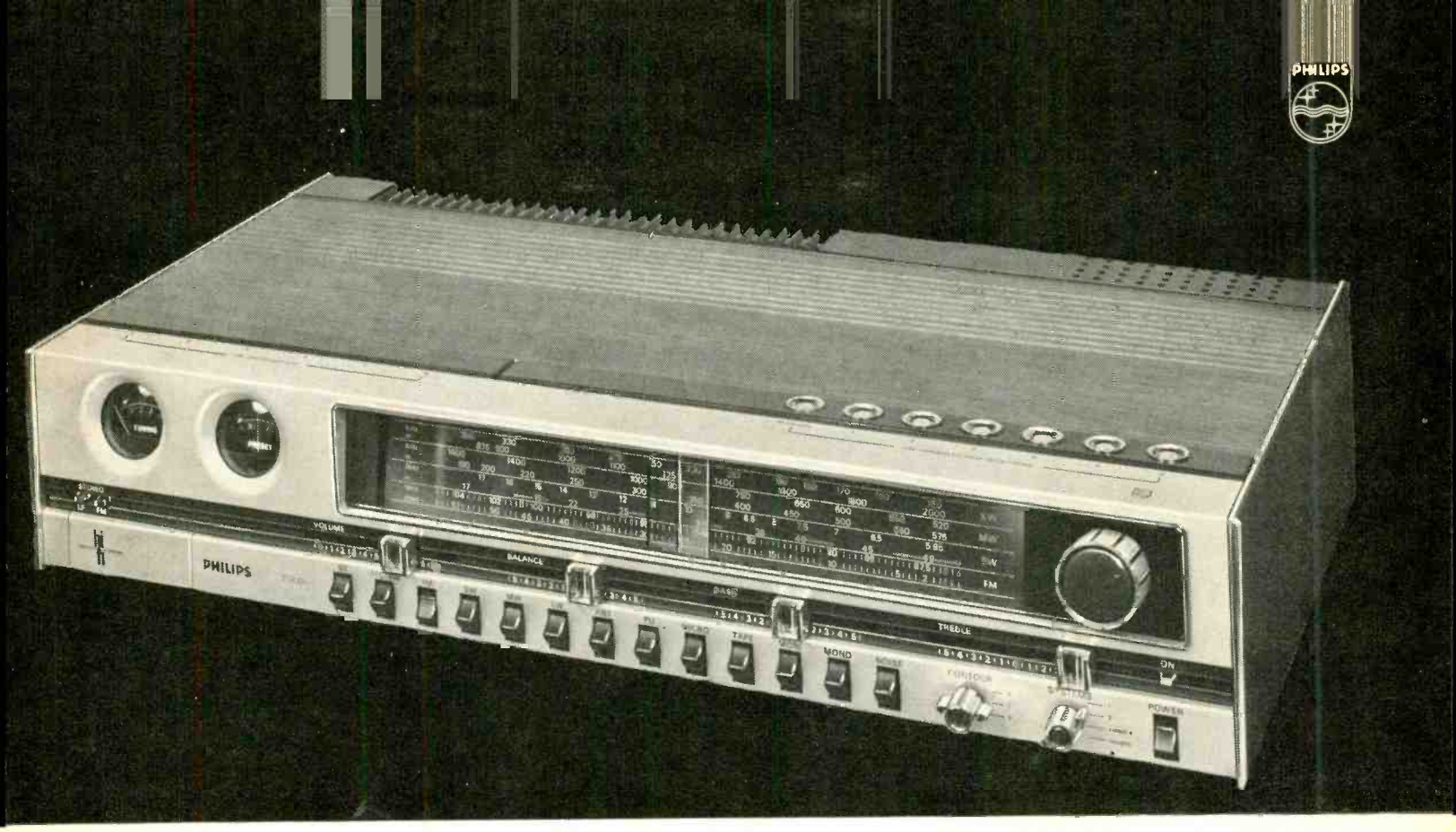

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Constructing a quadraphonic capacitor microphone

PART TWO

JOHN FISHER

THE ORIGINAL basic stereo microphones I built were designed to require the minimum of machining, apart from the capsules, and indeed the cases could be made up with little more than a fretsaw, hacksaw, file and soldering iron.

However, a microphone useful for both two and four channel work implied a need for the capsules to be rotatable relative to one another. Rotation through nearly 90° is possible if the swivel arrangement is so designed, but it was felt that ±30° about the nominal 90° setting would be adequate for most purposes.

The latter system meant that each half could be linked by six grubscrews running in a channel of one and fixed to the other. A fixed bolt in the channel half provided a form of endstop which prevents the leads being accidentally twisted too tight around a capsule. It also meant that machining was inevitable so yours truly learned to use a lathe all over again! It would have been possible to make up a unit with two of the small capsule shields used on the original stereo microphones but the result would almost certainly have been ungainly and easily damaged. It was also felt that the gauze could with advantage be further away from the diaphragms to help improve shielding from draughts.

Much of the case material is chromed bronze and copper. At the time I started machining, it was the only material available in approximately the right sizes. I would have preferred a hard aluminium alloy which would have saved the cost and bother of having the parts plated and should have cost a fraction of the price of the bronze. I have since discovered that television aerial erectors can sometimes be persuaded to part with the mast of an old Bands One to Three array which, with the cross pieces, should provide the sizes required.

The end clamping rings (1, 9 in fig. 7) are parted from the same piece of tubing as the main capsule housing (6, 7). The rings are drilled 10 BA clearance and the recessed ends of the housings tapped 10 BA to take the bolts. The upper capsule support is cemented to the mounting plate (4) with Araldite and this is bolted to the upper gauze disc (2) which is made from the same material as the side gauzes (21, 22). I used the fine Isopon aluminium gauze supplied for reinforcing Isopon resin; it is about the right mesh, bright finished, and looks attractive. It is on the soft side though and, if anyone makes a habit of maltreating his microphones, I suggest something like stainless steel gauze if he can get it. The Isopon gauze (available from Halfords) has proved quite successful however; it is really a fine expanded aluminium mesh and is more easily handled than a woven gauze.

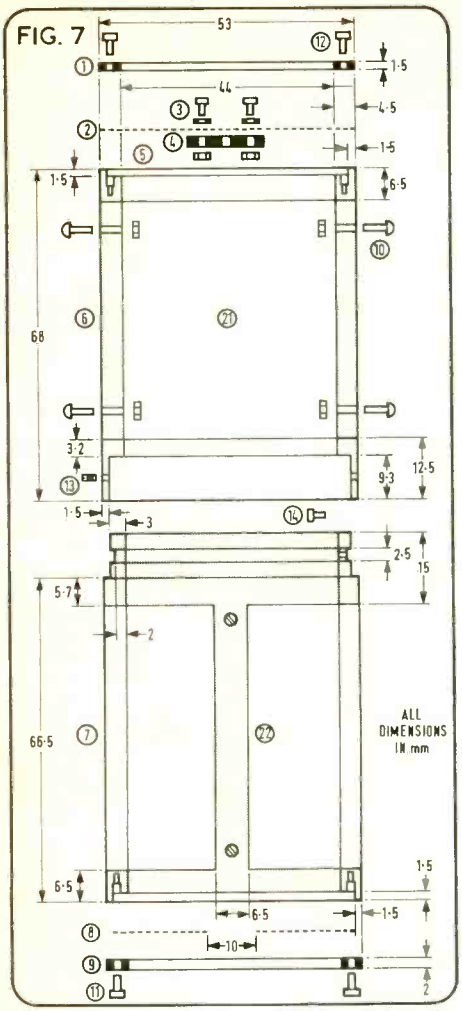
The lower gauze ring (8) is a much coarser and stiffer expanded aluminium as it has to take the strain of the weight of the capsule housings and provide a stable linkage to the amplifiers and body of the microphone. To keep out flies and small insects, and to some extent to damp any reflections from this area, the heavy gauze is lined with two layers of best quality tensioned ladies tights! The prototype uses a very pale 'natural' nylon weave but a very attractive deep blue pair of tights were contributed shortly after the microphone was completed. However, being inside the microphone, they are fairly discretely hidden and the colour is of little consequence!

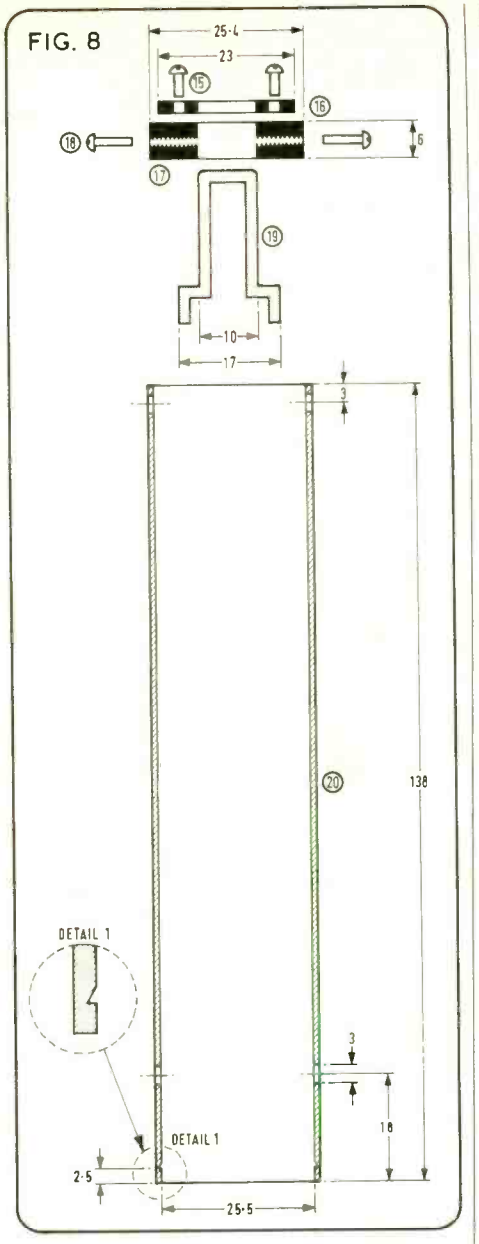
The overlapping sections of the capsule housings at the swivel joint must be machined so that they are just a sliding fit. The grubscrews (13) are cut and their ends polished so that, when a sliding fit in the groove of the inner section, the heads are flush with the outside of the microphone casing. They are secured in position with a drop of Humbrol silver enamel run over the heads and into the top of the threads. (The same enamel is very effective in touching up matt chrome, incidentally, and can be painted into scratches with a very fine squirrel hair brush.) The single bolt from the inside (14) must be inserted beforehand so that it acts as a stop between two of the grubscrews.

The coarse gauze is clamped to the brass plug (17 in fig. 8), which forms the end of the amplifier assembly, by a disc (16) which is drilled 8 BA clearance. The plug is tapped 8 BA to take the bolts (15) and also drilled and tapped from the side to take the locating bolts (18) which hold the plug in the end of the amplifier tube (20). The plug also carries a very slightly tapered plastic support (19) for the lower capsule. This can either be turned from plastic rod or a suitable stopper from household adhesives can be used. The capsule, or rather its supporting rod, is again cemented to this with Araldite. The rod passes through a hole in the end of the plastic part and the plastic must also be drilled to take the four signal leads from the capsules, two centre-plate leads and an earth lead. Connections to the capsules are best made with the very fine insulated and coloured flex available at modellers' shops. Some care will be needed in arranging the leads to the upper capsule which must be long enough to allow servicing of the latter capsule if necessary yet must touch the diaphragms of neither capsule.

The plastic capsule support can be a tight ram fit or can be cemented into the brass plug. The edges of the inner and wider portion of the plastic support are drilled in 12 places to anchor two negative and two positive busbars and provide anchor points for components.

ITEM	DESCRIPTION	QUANTITY	MATERIAL
1	Clamping ring	1	Bronze (chromed)
2	Gauze disc (fine)	1	Aluminium
3	10 BA CH bolts, washers	4 of each	Brass (chromed)
4	Capsule mounting plate	1	Aluminium
5	10 BA nuts	4	Brass (chromed)
6	Upper capsule housing	1	Bronze (chromed)
7	Lower capsule housing	1	Bronze (chromed)
8	Gauze ring (coarse)	1	Aluminium, lined nylon tights
9	Clamping ring	1	Bronze (chromed)
10	Gauze retaining bolts, nuts (10 BA R.H.)	8	Brass (chromed)
11	10 BA CH bolts	6	Brass (chromed)
12	10 BA CH bolts	6	Brass (chromed)
13	8 BA grubscrews	6	Brass
14	8 BA CH bolts	1	Brass (chromed
15	8 BA RH bolts	6	Brass (chromed)
16	Clamping ring	1	Brass (chromed)
17	Brass plug	1	Brass
18	8 BA RH bolts	6	Brass (chromed)
19	Insulating capsule mount	1	Polystyrene
20	Amplifier housing	1	Copper (chromed)
21	Side (window) gauze	1	Aluminium
22	Side (window) gauze	1	Aluminium





As previously mentioned, the junction of the fet gate lead with the gate-leak resistor and capsule lead is left floating to provide the highest possible insulation at that vital point. The ht is brought up the centre of the amplifiers.

The amplifier casing is simply a piece of tubing that mainly needs drilling and facing after cutting to length. One important detail is the retaining slot for the locking device on the *F & E* plug. My own microphone uses the insert from a male eight-pin Cannon *F & E* plug which is retained by the self-tapping screws that normally hold it into the Cannon housing, with holes drilled in the microphone body so that the heads of the self-tappers are flush with the outside of the casing. To replace the locking groove of the Cannon plug shell and allow a female plug to be mated and retained, the inside of the tube end was hard-soldered to reduce the clearance and turned to clean the job. A right-angled sawtooth groove was then cut (shown exaggerated for clarity) into the inside of the casing some 2.5 mm back from the end and this retains the spring-loaded locking device of the female plug.

I would not make a practice of suspending the microphone from the plug because there could be fatal consequences for anyone sitting below if the locking arrangement failed. In fact it appears to be quite safe and provides a secure electrical connection.

This concludes the description of the microphone casing and mechanics. I have gone into some detail in the hope that it will save time for anyone contemplating constructing a similar microphone. The design leaves much to be desired in terms of being elephant- and idiot-proof, but seems to work. The amplifier casing has deliberately been kept smaller than the capsule housing in order to minimise the obstacle effects it could have on the frequency and polar responses. On the other hand things have not been condensed quite as much as they could have been, simply because the difficulty in assembly seems proportional to the square of the number of channels and anything smaller would have been a nightmare to wire.

Electrical construction details follow next month.

out by BBC research engineers who tested the studios and made bass-cut filters for each microphone to suit local acoustics.

A hum problem arose from the fluorescent lights and ventilation, because of the fairly small size of the studios. When using the Calrec in cardioid pattern for large discussions, the mic has to be pointed with its dead side upwards to reduce studio noise, whereas it would normally be used with the dead side nearest the table to minimise pickup of paper rustling.

A stroboscopic effect occurs from the fluorescents if all the wall treatments are painted the same colour. The lights give off a square-wave illumination which interacts with sound diffusing holes round the walls and tends to send you to sleep. Several acoustic tiles have been painted a different colour to break up the strobe pattern.

Studio Two is where news, weather and live music programs other than disc originate. Disc programs are originated from studio One, as are live discussions and 'Phone Forum'. Studio Three is a network studio consisting of a Pye two channel mixer, microphone, telephone and tape recorder.

Studio One is 6.5 x 5 x 3m high. Studio Two is 6 x 4.6 x 3m high. Studio Three is 4.3 x 2.9 x 3m high. Discs for transmission are mostly received as advance publicity copies from the record companies. The station also buys a few discs and tapes and there is an arrangement with a local retailer whereby cassettes are borrowed for review.

Needle time is restricted to one hour a day, inclusive of tapes as well as records, and to this end a note is kept of all music played.

Radio Blackburn, in common with most of the other local stations, are now capable of transmitting on both mw, am and fm.

On fm, there is 1 kW power output into the aerials giving an effective radiated power (erp) of 1.5 kW. On am the power output is 500W. As the aerial has little gain, this gives an erp of 500W which will be raised next year to 1 kW radiated.

The fm pattern radiated is slightly egg shaped, being modified by the contours of the land. Am pattern is virtually omnidirectional.

The fm primary service area is about 24 km radius and the am primary area about 16 km radius. Secondary service areas are 40 km fm and 40 to 50 km am with reports well outside the service areas of both, from Holland on am and Scandinavia on fm. (The primary service area is defined as that within which a signal strength of 1 mW is measurable at the receiver aerial terminals. This is also the standard for commercial radio.)

The fm transmitter aerial transmits at a slant angle of 45° to give a circular field. The field is anticlockwise when looking to the transmitter from home.

On the whole, I found the station was very well run by an enthusiastic team whose programs were excellent in quality considering the facilities available. Now that local mw broadcasting has arrived, it gives yet further scope for the staff of BBC Radio Blackburn. Local radio has a rosy future if all stations are as well run and maintained as this.

By Roderick Snell

VIDEO TAPES COMPARED

VIDEO TAPE plays a far more critical part in a recording system than does its audio or computer counterparts. For a start it costs between £60 and £100 per hour on a quadraplex broadcast recorder. Even on the low cost Sony 12.5 mm vtr, it costs £15 per hour at current retail prices. Tape for 25 hours recording will still therefore cost more than a new machine. Another problem with video tape is its unreliability. Until quite recently, at least, tape faults caused more breakdowns at broadcast and industrial levels than any other part of the tv chain. The BBC discovered that cigarette smoking in their operational areas could cause vtr head clogging and, at the other end of the scale, some early users of 12.5 mm vtrs found it necessary to warm their tapes before using them in winter.

The sharp tips of the rotating video heads, projecting about 100 μm into the tape surface and moving across it at speeds of around 10 m/s, impose far greater stresses on the tape than either audio or computer systems. Despite the greater care and closer tolerances that apply to video tape manufacture, there can consequently still be greater differences between two tapes from the same production batch than there are between two tapes from different manufacturers.

About 20 different types of 12.5 mm video tape have been tested at the University of Sussex during the last three years and there are currently over a dozen types worthy of review. To do each justice would require using several samples of each on two or three different models of recorder, preferably over a period of several months. Those wondering why no one has yet published a thorough survey of video tape may get an idea of the problems from recent experiences with products of two of the best-known American-based tape companies. A sample of 12.5 mm tape from company *A* worked very well for many playings on our Shibaden *SV700* recorders so 20 more reels were bought. About half of these worked well when first used although the first minute or so tended to clog the heads. When we discovered this, we cut off two or three metres where necessary and then tested each reel by recording a continuous test signal and spot checking throughout the reel; 11 of the 20 tapes clogged the heads so badly that they were useless. After many technician hours, we had nine tested tapes which could be used for master recording. Although each tape *recorded* satisfactorily, we found to our horror that they deteriorated with time so that after a few months none would play back without continuous clogging. By this time the replacements for the original 11 rejected tapes had arrived, bearing neat gold labels announcing a super new oxide formula: they were just as bad!

The sample from company *B* looked much more promising in having a mirror-smooth oxide surface which, with its better head-to-tape contact, gave crisper pictures and no trace of clogging. We bought 35 reels and these at first seemed to be trouble-free until we found that the tape seized on to the head drum near the end of certain reels. In minor cases of the disease, vertical edges in the picture simply became unstable like a wavy dissolve in broadcast television. In worse cases the tape actually squealed to a stop and snapped when we tried to rewind it. Eight tapes were returned with this peculiar fault but it took rather longer to discover the most sinister characteristic so far: exclusive use of this tape reduced the life of the metal heads of our *SV700* Shibaden by about 50 per cent. As this was not normally more than 600 hours, it would have meant returning the machines to the importers for head replacement every 300 hours. Anyone trying to identify brands *A* and *B* can relax; both types are now discontinued and their successors are much better behaved.

The behaviour of these two video tapes was described in detail because they were at opposite ends of the spectrum of possible oxide formulations. Type *A* was a soft oxide which gave extremely good head life and certain types of video head (our Shibaden among them) gouged out the soft material to a degree dependent upon the temperature, the humidity, and the particular sample of video head in use. New heads gave the most trouble because they had sharper edges and greater penetration of the tape surface.

Type *B* was the opposite extreme with a very hard highly-polished oxide. This gave good head-to-tape contact with a consequent improvement in resolution but at the cost of increased head wear. It seized into the smooth surface of the head drum near the end of the reel because the back tension was high at this point. Needless to say, makers of brand *B* did not themselves manufacture video recorders.

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TABLE 1 Tape consumption

Recorder	Tape width (mm)	Consumption (swept area in cm²/s)
Broadcast Quadraplex	50	190
Philips VCR	12.5	18.2
Sony U-matic	18.9	18.1
Philips LDL 1000	12.5	21.3
Sony CV2100	12.5	37
Shibaden SV700	12.5	21.5
EIAJ/1 (European form)	12.5	20.6
Akai	6.25	17.8
Ampex Instavideo* (extended play mode)	12.5	10.3

*The Ampex instavideo project has been abandoned.

TABLE 2 Signal to noise ratios of tapes tested. Figures are comparative only.

Type	Sony CV2100 ACE	Shibaden SV700 Ec
Sony V32	40 dB	43 dB
Shibaden	—	43 dB
Chroma 80	41.5 dB	44.5 dB
3Ms 363	38 dB	40.5 dB
Dixons	37 dB	40 dB
3Ms 461	42 dB	45 dB

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The good samples of tapes *A* and *B* both gave much better results on a Sony *CV2100* recorder on account of its wide track ferrite video heads which gave less clogging on tape *A* and, due to the hardness of the ferrite, would probably have given 1,500 hours use with tape *B*. The cost of this decreased susceptibility to tape troubles is, of course, a tape consumption 1.8 times greater than that of the Shibaden.

Video recording economy

The most important machine-dependent parameter seems simply to be the area of tape consumed per unit time. **Table 1** shows a few examples.

The Sony *U-Matic* and Philips *VCR* and *LDL 1000* might seem to be three of the most economical but this is not allowing for the fact that all three are designed for exclusive use of chromium dioxide or high energy tapes, which cost 20 to 30 per cent more than conventional tapes at the moment. It is worth noting that the Akai 6.25 mm recorders are not quite as economical as they seem because the tape costs slightly more than half an equivalent quantity of 12.5 mm tape. Real tape costs depend on many variables; three important ones are:

1. The cost per reel. Educational and industrial users normally qualify for substantial discounts and these often differ vastly between suppliers. Also, the break-points for quantity discounts are often different so that, for example, ten tapes from one distributor will be at the one-off price while from another will attract a quantity discount. Some suppliers are also willing to allow large-quantity discounts on an undertaking to buy a certain number of tapes within an agreed period of time.

2. Tape life. Modern tapes last for at least 15 minutes on a still frame, which is equivalent to 45,000 passes. Open reel tapes are generally discarded after 50 to 1,000 playings; not for actual wear but through damage due to rough handling, spooling, braking or dirt and dust. Keeping the brakes and tape transport smooth and clean and using a plastic dust cover over the reels and drum can double the useful life of the tape. As tapes are usually rejected when the dropout exceeds some arbitrary annoyance value, a dropout compensator of the type fitted to the Sony *U-matic* and Philips *VCR* recorders (which makes 95 per cent dropouts invisible) will clearly extend the tape life by a large factor.

3. The picture quality needed. It is clear from (2) that the tape life can be extended if the standards are lower but the possibility of starting with a lower grade tape should also be considered. One local authority discovered a computer tape which worked fairly well on their *CV2100* Sonys and used hundreds of reels without any trouble (one must be very cautious here, for very few computer or audio tapes work at all with video equipment and some of them wear the head viciously). Racal-Zonal, incidentally the only company actually *making* video tape in Britain, have recently broken new ground by releasing a lower grade version of their *HV-25* 12.5 mm video tape. Coded *GP-25*, it costs about 20 per cent less than *HV-25* and is only inferior in terms of dropout.

Tape comparisons: 18 different types of 12.5 mm video tape were tried but the complications described above made it impossible to offer comparisons fair enough to publish. Four types were therefore picked out, each of which was notable for one feature or another. Sony *CV2100* and Shibaden *SV700EC* recorders were used for all the tests because they together form the majority of open reel 12.5 mm machines in Britain at the moment. It is realised that the tests will soon have to be repeated on a selection of the new EIAJ/1 compatible recorders which many companies are releasing.

Dixons Budget Tape

This retails at just over half the price of its competitors. It is a white box of unbranded tape and the distributors are unwilling to reveal its origin. My guess is that it is Racal-Zonal, who wish to remain anonymous. Dropout and noise were certainly greater than that of full-price tapes, on both recorders. The noise was most noticeable on the Sony and the dropout on the Shibaden. This greater tendency to show dropouts is characteristic of a recorder with a narrow video track and, for those interested, *Video Talk* Volume One, Number One, 1968, available from 3M Company, described tests relating dropout to video track width. The tendency to clog heads on the Shibaden was also slightly above average but still not too serious. Well packed on a good quality reel, Dixons budget tape is clearly a proper helical scan video tape, not a computer or audio reject. The individual user must decide himself whether the video performance is acceptable; at least one Sony user here found this tape satisfactory for his many less critical recording needs.

Memorex Chroma 80

Despite its title, this is neither a chromium dioxide nor high energy tape but is the best example of a highly developed ferric oxide type. It does have a fractionally increased coercivity but not enough to need any rebiasing of the recorder. It is unlikely that this small increase would explain the low noise level, which we found to be better than all the tapes tested except 3M high energy and Dupont chromium types. Dropouts were as few as displayed by the best tapes, and the clogging tendency on the Shibaden about average. The low noise was particularly useful on 12.5 mm colour vtrs.

Scotch 363

This uses the standard 3M ferric oxide coating on a tensilised backing 42 per cent of the normal thickness, giving a total reduction in thickness of 30 per cent. In theory, this would give a 30 per cent increase in playing time but in practice 3M do not quite fill their 18.5 cm reel so the increase in playing time is only 25 per cent. This is nonetheless a worthwhile increase for both machines, giving 50 minutes on the Sony *CV2100* and 90 minutes on the Shibaden *SV700*. *363* tape is more delicate than normal tapes and will certainly be damaged if either machine has badly adjusted brakes or is carelessly used. The smaller reel sizes used on the battery portable vtrs were quite robust and the tape can be particularly recommended for the Sony, Shibaden and Nivico portables. Unexpectedly, the video noise level was a little above average on both machines but the time base stability (see later explanation and **fig. 2**) was better than on any other tape tested.

Scotch 461

The much-publicised high energy tape. The increase in coercivity is achieved by cobalt loading the ferric oxide mix which, like chromium dioxide, gives a *possible* increase in recording density of about 25 per cent. Usually the full benefits can only be obtained from machines specifically designed for this kind of tape, like the Philips *VCR* or the Sony *U-matic*, but some improvement is found on most recorders. As can be seen from **Table 2**, the reduction in noise was good when compared with normal tapes but was not much over Memorex *Chroma 80*, at least on the *CV2100* and the *SV700* recorders. More recording current was needed and we could not quite achieve the increase in output shown in the 3M graph (**fig. 1**). More modern recorders will probably show the real benefits of high energy tape, but in the meantime, where it can be afforded, it will give marginally the best performance on Sony *CV2100*s and Shibaden *SV700*s.

General notes

Head clogging is exacerbated by temperature and humidity variations so sufferers should first check their tape storage conditions. A

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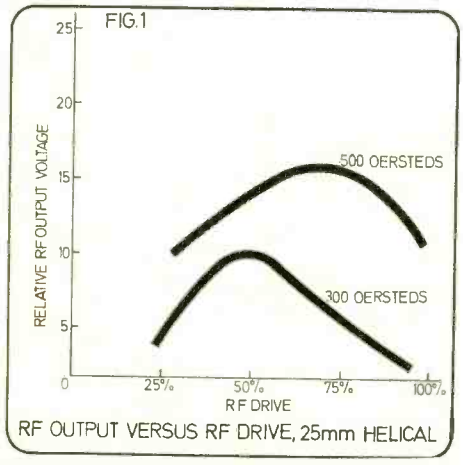

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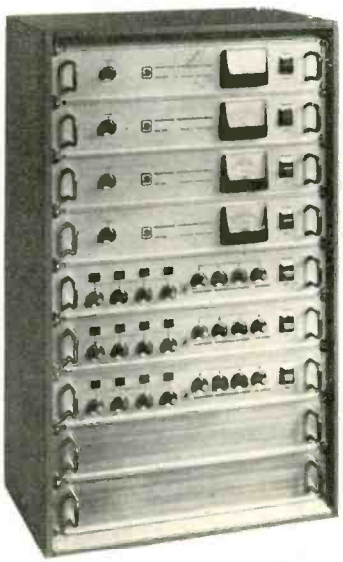

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AROUND THE STUDIOS

ADELPHI, WASHINGTON

By Adrian Hope

WHEN IN New York, I told some studio engineers that I was going to Washington for the weekend. The immediate reaction was 'Whatever for, there aren't any studios in Washington are there?'. I answered each time that I was going to Washington for a rest, which I was.

Silver Spring, Maryland, is about an hour or so by car out of Washington proper, through beautiful parkland complete with white water stream and notices warning that it is polluted and a health hazard. Silver Spring itself is a typical little American town complete with main highway, a crossroad with a petrol station on each corner, little Southern-style wooden houses, and a generally lazy atmosphere. It is in one of those houses that Gene Rosenthal and Gayle Moore run Adelphi—a record company, recording studio, publishing company, record distribution company, and probably a whole lot more besides. But their area of interest is fairly small, as are the companies, and between them they explained the difficulties involved.

'If you have a record label that has issued only a couple of recordings, then it's a hobby. When you've got about 20 albums on issue then it's a business. It's the no man's land between two and 20 that's kind of odd and that's where we are now. It's neither a hobby nor a business.

'What we are doing is to go out with field recording equipment to the areas down south of here and record blues and country singers who have never been recorded by a major label. We see it as both a duty and a challenge. If we don't record these people, no one will. And although it may sound a bit bizarre, it is all something of a race against time. They are all old and in a few years, if they haven't been recorded, they will have died together with their songs and music.'

I asked whether Adelphi Records pay royalties to their artists.

'We try to pay royalties but we can never pay enough. If you run a blues label of this kind, the best you can ever hope to do is not lose money. And it is difficult to explain to an old man that, just because he has made a record and his friends will buy a dozen copies, he is not going suddenly to get rich.'

Rosenthal and Gayle Moore think highly of the British market for their material and are grateful for what BBC men like Mike Raven are doing to promote the field. But they resent bitterly the motorised bootleggers who record back-country blues material without making any payment to the singer.

I asked why there appeared to be no large studios in Washington. Rosenthal explained that most of the recording in that city has been handled by film studios. Thus the only really successful studios in the area are likely to be those, like his own, where there are virtually no overheads.

Adelphi already have enough tapes to master around 40 or 50 issues.

'We can record far faster than we can issue,' said Rosenthal. 'But we must keep recording if we are to collect this material before the artists die.'

Running a studio along such lines calls for what Rosenthal describes as 'shifting priorities'. When I arrived, he was in the process of setting up a session with Paul Jeremiah who had come over to stay for a few days and record some of his country blues. Jeremiah, a young performer, instanced the fact that Adelphi are now tending to record contemporary music. These recordings are exceedingly clean and crisp so I was quite anxious to see what equipment Adelphi were using.

The studio is small and built into the basement of Rosenthal's house. Every available dollar has gone into equipment and, although the operation is in some respects on a shoestring, the equipment crammed down there is surprisingly impressive. Two Altec *604E* monitors are used with four much smaller KLH monitors for four-track playback. Although most of the field recordings must be mastered in stereo, Rosenthal has some impressive four track studio equipment. There is a Scully two-track convertible to four track along with a four track Ampex *350* warhorse fitted with *351* electronics. Most interesting is a Sony *ES-22T* which he bought a couple of years ago. This is a stereo machine which was clearly made for the American market. Rosenthal regards the Sony as having been years ahead of its time, using plug-in card components and sturdy mechanical workmanship.

Another mild surprise was finding two *B & K 124* graphic equalisers. These have 25 slide controls arranged in third-octave steps between 63 Hz and 16 kHz. Rosenthal finds them ideal for cleaning up field recordings made with poor acoustics. The FBI, he said, use them to clean up their bugging tapes. Mains hum can be extracted by using a single slide set to give a very tight 50 dB notch. Rosenthal once found that a Nagra had unaccountably put a 10 kHz tone on a field recording. He lifted this off the tape at the dubbing stage with the 10 kHz slider. Another use for equalisers of this type is in remastering old 78s. Scratch can be pulled out of very narrow bands rather than by simply rolling off above a given frequency and thereby deadening the whole thing.

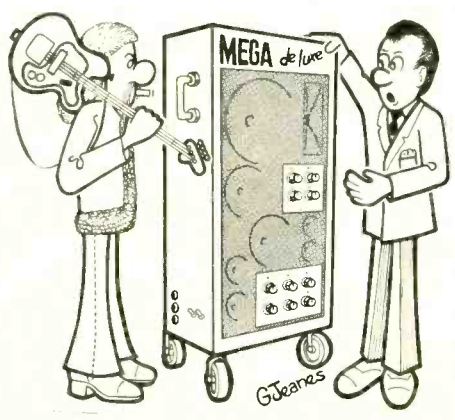
The 24/4 studio mixer was built by Rosenthal and has taken several years to put together because it was only in the course of use and design that he found out what he really needs.

'By pulling from the mix bays to the outputs, as opposed to sending from the inputs, we have freedom outside the normal fixed pan pot limits,' Rosenthal insisted. The disadvantage is that it takes a fair time to set up the board because, unless the engineer is well familiar with it, it is necessary to normalise each time before use and then reset. But, for an operation like Adelphi, time is not necessarily money.

Adelphi have two Advent units made under Dolby *B* licence which they use to keep the hiss down in multi-generation recordings.

Adelphi use Neumann, Sony and Electro-voice microphones in the studio (which has a capacity for six performers), and a Sennheiser shotgun mic for field work. The amps are McIntosh and for general work AKG phones are used. For mastering, Rosenthal uses Koss *ESP9* phones.

I left them preparing to record Paul Jeremiah. With all the dollars invested in equipment, nothing was left over for soundproofing. But Silver Spring is a small town and very little noise filters in from outside. If anyone upstairs runs a tap, water noises may emanate from the basement pipes which run down one side of the studio. But the answer to that one is quite simple. When they record at Adelphi, nobody upstairs runs a tap.



'With this one you have to give 30 minutes warning to the Electricity Board.'

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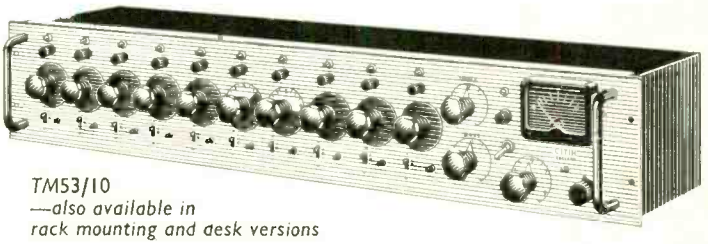

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DIARY

By John Dwyer

A LITTLE WHILE ago Harry Roach took his Constellation into **CTS** at Wembley to record an album. The sessions, which lasted two days, were the first he had undertaken in a freelance capacity, all his previous work having been for EMI. His contract expired on January 1.

He was clearly excited about the album and its prospects, as was the producer, Ken Barnes, author of *Sinatra and the Great Song Stylists*.

The line-up was Harry Roche, Don Lusher, Bobby Lamb, Ken Goldie, Ric Kennedy, Johnny Edwards, Nat Peck, Keith Christy, Bill Geldard (trombones); Greg Bowen, Bobby Houghey (trumpet); Roy Willox (reeds); Joe Mudele (bass guitar); Alan Branscombe (piano, organ and Fender piano); Bobby Orr (drums); Martin Kershaw, Judd Proctor (guitars); and John Blanchard (percussion). As Ken Barnes put it, brass playing in London must have come to a standstill.

Ken said it was his third album with Harry, who has played with such up and comers as Ella Fitzgerald, Lena Horne, Henry Mancini, Frank Sinatra and Tony Bennett. He said that the sale of the album had yet to be negotiated but that they were hoping to break into the international market, something that wasn't really possible under the previous arrangements. For this reason he and Ken had decided to go out on their own. Eileen Didlock, wife of John Didlock of Scully Metrotech, had formed a company to provide the necessary backing, and the result was the sessions we were now about to hear.

Since the sessions the album, *Sometimes*, has been mixed in quad at Pye and will be released in June encoded in SQ. The follow-up is now being planned.

Before the sessions had started, Ken told me a little about the band. 'This band has been developing over the last four years. It's a working orchestra. They've made about 260 broadcasts on Radio Two and they've even been on tour to Saudi Arabia.

'This particular set is all new stuff; they haven't seen the scores before. In the Constellation the reading is exceptional. British musicians are the best readers in the world. Here we can do an album in about two and a half sessions, whereas in the USA it would take at least four.'

We talked a bit more about the present album: 'I think,' said Ken, giving me a great quote, 'I'd describe the kind of sound we want to make as Tijuana with Muscles. We want a big, warm, wrap-around sound. We're selling melody and we're selling beat, aimed at the living room—the sound people want in their homes.

'We'll be doing some disco things but nothing too heavy. We'll be doing a blues by Stan Tracy tonight which is a pure Jazz track to give the boys a good blow.'

I asked him why they had chosen to do the sessions at CTS. 'Other studios were too live for what we wanted. We wanted a fairly dead acoustic without having to use too many screens. That way the musicians can see one another and play as a unit. One of the most important things is that it has a car park.

BGS Productions control room centred on an Electrosonic *12/4*.

The control room was quite crowded. Ken Barnes huddled at the desk in conference with engineer Dick Lewzey and tape op Mike Sykes at one end, Stan Britt and self discussing 'whatever happened to so-and-so' at the other, and a whole lot of arrangers and wives of arrangers and musicians in between. Altogether it was as if the clock had slipped back a little. The talk was of Tubby rather than T. Rex, and the words used could have been by Damon Runyon out of Nat Hentoff.

Everyone was happy. Every once in a while Ken Barnes looked up from whatever he was doing with a big grin on his face for whoever happened to be looking his way at that moment. Another man in the corner of the control room stood holding what must by then have been a very heavy telephone handset at arm's length so that his wife could hear the playback. It was that kind of session.

The very suave Harold Roche is quite a character, as they say. I spent a very entertaining few minutes with him during tea, but little of the wit and wisdom that issued from the burly crew-cut, bright-yellow-sweater-clad figure before me was fit to print in such a magazine as we have here. He told me one story about getting his charts soaked in Guinness in a most unlikely way, having left them next to a crate of the evil stuff in the back of his beat-up Jag. After the telling of which he remarked that it was the first session he'd had anything to do with where the charts were drunk before the session men.

About the session itself there's little to say except that the repertoire varied from Stevie Wonder's *You're the Sunshine of My Life*, through Mancini's *Sometimes* to the Rodgers and Hart classic *My Romance*, and that all the tracks I heard were played brilliantly. I remember one pick-up the band had to do right in the middle of *Sunshine;* it was a climactic passage that I would have thought a musician would need to build up to. Not so. They all jumped straight into it without a trace of untidiness. To me it was a feat rather like clearing a five-bar gate without a run-up. It also contained some really beautiful sax and flute work by Ray Willox. Pete Moore arranged *Sunshine*, Bill Geldard did *Romance*.

Another memorable track was a raunchy version of *Watch what Happens*; as the literature of my youth would have said, it was so far out they don't run trains there any more. Altogether I wish I could have heard the next day's sessions as well.

I have some news about the Wembley complex itself. Most of the work that is going on there now seems to have been attracted by CTS. In February they worked on seven films, as they had in the previous month, and they said they would be doing a new one in May. The seven February films were Ringo Starr's *Count Downe* for Apple Films; *The 14* for Avianca Productions; *Scorpio*, which starred Paul Schofield and Burt Lancaster, directed by Michael Winner, produced by Walter Mirisch, music composed by Jerry Fielding and engineered by Dick Lewzey; *Vault of Horror* for Amicus Productions; *The Little Prince*, for Stanley Donen Enterprises, produced and directed by Donen, music composed by Alan Lerner; *The Yellow Dog*, produced and directed by Terence Donovan, music composed by Ron Grainer; *The Going Up of David Lev*, for Synchro Film Incorporated, music composed by Jerry Goldsmith; and *Jack the Giant Killer*, for Mc Productions.

More recent film work includes Gulliver's Travels, for Valeness/Belvision. This is a musical version of the Swift satires and stars Richard Harris. The music was written by John Barry to lyrics by Don Black. John Barry has also been working on *A Doll's House*, a film of the play by Henrik Ibsen which, because of the current discussion about the role of women in society, is also enjoying a revival in the West End starring Claire Bloom. Three other films are *Nightmare Park*, *Hitler—the last ten days*, and *Dracula is Dead and Well and Living in London*.

As this is written, they are working on *Theatre Macabre*, for which the dialogue director is none other than Louis Elman; *O Lucky Man*, produced by Michael Medwin and directed by Lindsay Anderson; *Last of Shelia*, for Warner Brothers; *Don't Look Now; Barcelona Kill; Master of Love;* and *Assassin*.

As I've discussed in this column on a number

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In May the bulldozers moved into Grosvenor Road, Birmingham, to transform the Midlands' leading recording studio into the most comprehensive modern recording centre outside London, including multi-track facilities up to 16-Track.

In the meantime, Hollick and Taylor are endeavouring to provide the same high-class service as they have done for the past 25 years and hope that their customers will not suffer any inconvenience as a result of their rebuilding programme.

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of previous occasions, De Lane Lea have been through a bad patch. But I'll risk my neck and say that they're over the worst, a view which the amount of recent work the Wembley complex has had would seem to confirm. They are also re-equipping with new tape machines: Studer *A80* and *B62* machines, and new film machine electronics. They have also ordered a 16 track recording console from Neve.

Neve have had to make some staff redundant, including Metcalf Collier, Ray Moore and Ian Macleod. Jim Lahey has left of his own accord. Bonochord, well set to improve Neve's finances, will increase prices and put in more production staff.

I also hear that Neve are supplying Capital Radio, winners of London's General Station, with a desk for their studio in Euston Tower Centre. Also in Euston Tower centre is the as yet unfinished studio of ex-Apple Engineer Claude Harper and ex-Rosko Producer for the Beeb, Aidan Day. They showed me the studio, called **Scorpio,** and I must say it is singularly smart, or it will be when it's finished. More anon.

I have some more detailed information about **Saturn** studios, whom I mentioned in November last year. Saturn's studio is owned by Worthing Recording Studio Ltd and, not unnaturally, is located at Worthing on the Sussex coast. According to Andy Cowan Martin, who handles all the studio bookings and public relations for Saturn, 'the complex offers a 16 track studio with eight-bedroom hotel accommodation on the premises. An accommodation charge of £1.50 per person per night is made for musicians. No charge is made for the production staff.'

Andy says that the studio measures just over 12m by 6m at the widest part, and that there is a street-level loading bay leading straight into the studio.

The control room's size is about 3.7m by 7.5m. It has a new Ampex *MM1000* 16 track tape machine, an Ampex *AG440* four track, Ampex and Studer two track machines, a Triad 18 input mixing desk, Lockwood monitors, and extra equalisation and compression facilities. Andy also tells me that the size of the studio viewing panel is almost 2m by 2.5m. He goes on to say that the combination of a good 16 track studio and a coastal location for hire 'at the silly rate of £12.50 an hour is, at the present, unparalleled anywhere'. At which, no doubt, every sand-dune from Sennen Cove to Stroma will turn out to have a 24 track studio beneath it available for hire at 5p a day including bloater sandwiches and Nescaff.

At any rate, Saturn seem to have attracted quite a bit of business since they went 16 track on March 5. Andy tells me they have done work for Liberty/UA, Warner Brothers, Tamla Motown and Decca labels, and Dave Lee Travis has played one of their singles, Brownhill Stamp Duty's *Hey There Lonely Girl*, on Pye, as a Radio One Hit of the Week. Saturn's chief engineer is Dave Ruffell, but as I have said, bookings are handled by Andy, whose number is Worthing (0903) 201767.

During the month I took a photographer to **Steenhuis Recording Studios** at Broadstairs. They are run by Paul Steenhuis, formerly of Adrian Kerridge's Lansdowne Studios and son of multi-guitar man Wout Steenhuis, and Clive Taylor. The studio is small and Paul and Clive make no pretensions about being able to record symphony orchestras—unless on location—but they are fulfilling a local need; that of groups who want to record in pleasant surroundings. As anyone who has listened to Radio Medway will know, there seems to be a lot of musical talent in Kent, particularly in the form of Country and Western groups.

Steenhuis offer four track recording and will soon be releasing records on their own label. Obviously Wout Steenhuis has used the studio quite a bit and the tapes have been accepted at EMI and the BBC. They have already released one lp of a country and western group, *Sounds Country*, on the Chance label, and they tell me they have been recording day and night in the two months that the studio has been open. They also do mobile work.

Their equipment includes a Teac four track machine and a Midas four group desk linked and matched to an Audix two group mixer. There are 12 mic lines into the Midas desk, six into the Audix. They use AKG, Shure, Beyer and Sennheiser microphones and one Reslo Ribbon, which Clive told me was 'brilliant on bass drum'. There are four Tannoy Monitor Gold speakers driven by Sansui amplifiers. All the monitor amps used for mobile and studio work are built by HH and they also have Sound City 250W stacks. There is a lot of other equipment in the studio which I haven't room to describe here, as well as loads of musical instruments.

What impressed me most about the little set-up was that the people who run it were refreshingly aware of their own limitations. Wout, who acts as a consultant to the studios, said he thought the two younger men were adopting the right approach: 'Get to know the equipment first,' he said, 'and then expand and expand'. He confessed that none of them knew the market for their studio since, although there was a local population of 100,000, a large proportion of these were old age pensioners. Nevertheless, judging by how busy they say they have been, and by the lack of any studios for their end of the market in the locality, I would say they will be very successful. Another factor, no less important, must be that they are such pleasant people to deal with. Steenhuis are on Thanet 24743 or 61914.

Mike Faudio

There must be plenty of 'Diary' readers who remember Mike Ford. At one time this bearded bespectacled Scot travelled the highways peddling EMI tape, after which he took to the roads bearing the good news about Sound Techniques desks. There can be few people in the recording industry better known and liked than Mike, a man about whom there are more stories than I can remember and certainly more than we could possibly print.

Not long ago he went back to Edinburgh and started a small wholesale company which he now tells me is doing remarkably well. Already he is making plans to open his second branch and is even talking of expanding back over the border, though that is a little way into the future as yet.

The name of Mike's company—and hold your breath—is **Faudio.** That's right: Faudio.

He sells a limited number of audio accessory lines to the retail trade, and his team of salesmen go round keeping the retailer supplied with products and with brochures, price lists and display stands for the products. Mike says that because the number of lines he handles is limited he can keep good stocks 'at all times'. Vans stuffed with all his lines buzz madly round their patches making regular calls on retailers at short intervals, and making same-day deliveries of orders phoned through before 12 noon. Dealers can visit a showroom, at Faudio's headquarters, where they can park for nothing and see the stuff on display. There must be lots of people that would like to wish Mike the best of luck in his new venture but, quite honestly, it doesn't sound as though he needs it.

On the other side of Central Scotland are the Glasgow premises of **BGS** Productions. BGS offer four track recording, tape to disc transfer, composing and arranging for records or films, and 16 mm film scripting, filming, editing and dubbing; they recently finished four industrial films and are now making another two. BGS, which is also the name of a group of musicians, can arrange backing tracks for vocals. BGS play trumpet, tenor sax, trombone, organ, guitar and bass guitar and drums.

The recording area at BGS is 5.18 by 4.57 by 2.47m high. In it there is a Challen piano; a Farfisa *255* organ with a Leslie *825* speaker and amplifier unit ; and a Premier Vibraphone, as well as various other amplifiers and instruments. The lighting is adjustable.

BGS's mixing desk is an Electrosonic 12/4 with full equalisation and cut, an lf filter on each channel giving 18 dB per octave cut below 25, 50 and 100 Hz; pan, foldback and echo send on each channel; and four echo returns. Each channel has a phase reversal switch. The faders are P & G *1520* and the metering is on four ppms. All the channels are routable to any or all of the four output groups.

BGS also have an AKG *BX20* reverb unit whose timing is operated from the desk; two Dolby A units; two Audio & Design *F700* stereo/mono compression, limiting and expansion units; a Brenell four track recorder with selsync; Revox and Ferrograph stereo recorders and a Skandia eight track cartridge recorder. For monitoring a Revox 70W amplifier drives two Rogers monitor speakers. They have four Calrec *1050* and two Calrec *625* capacitor

Left: Paul Steenhuis (l) and Clive Taylor at the Steenhuis Audix-cum-Midas.

Adjacent: Institute of Audio Research co-founders Albert Grundy (r) and Irwin Diehl (l) holding class at Ultra-Sonic Recording Studios, Hempstead, NY. Tonmeisters American style.

microphones, two AKG *D19*, one *D202* and four Shure *Unidynes*. There are two direct feeds for guitars. BGS live at Newtown Street, Kilsyth, and the daytime telephone number is Kilsyth 823291. They charge the following rates: four track, £6 an hour; £1 an hour for stereo; reduction £5 an hour.

Orange, London. The new Compton Street studio has now installed a new British-built Amity 16 track 50 mm machine.

As most of you will know, Amity is the company with which Orange is associated in building their 16 track 25 mm machines which caused so much interest last year. I asked Dave Humphries of Orange why they felt it necessary to go back to 50 mm tape widths. 'Well, when groups come in they sometimes want to use their own tapes. It's for compatibility reasons really.' He also told me that Orange had not yet made any production versions of either the 25 mm or 50 mm tape machines. Hmmm.

The Orange studios have been used by Ned Sherrin, who produced the score of a stage musical written by John Cameron. John Lewis of Terry Dactyl and the Dinosaurs wrote, sang, played Moog piano, organ and guitar on and produced his new single at Orange for Sonet. Dave Humphries of Orange produced a single for German CBS by Steffan Waggershausen and mixing has been completed of tracks by an Irish group called Freshman, under the production of Tony Rivers.

Punne

Marquee, London. Marquee have provided me with the most merciless pun of the month. Having told me that Stomu Yamash'ta's backing group, Suntreader, have been in to do a new album, they ask: 'Was it Stomu who wrote "Yamash'ta been a beautiful baby"?'. Well, without looking it up I can't say for sure but I suppose he could have Dunne.

Paul Brett has started another album with engineer Geoff Calver following the release of his last one; Sally Angie has started her first lp with producer Jimmy Horowitz; a Mike Starr album is being produced by Tony Atkins and engineered by Geoff Calver; another first album, this time by Strider, is being produced by Jimmy Horowitz with engineer Phil Dunne; a Marquee regular, Robert Kirby, has been working on film music compositions with Caleb Quaye, B. J. Cole, Ann Odell, Peter Robinson, Barry De Souza, Bruce Rowlands, Mick Audsley, Doris Troy, Philip Goodhand-Tait and some others; singles made by Barry Leng and Alan Philips. Producers Alan Field and Mike Redway have worked with the 'Brothers Lee' and Barry Evans, as well as producing a new single by Mike which Marquee say can't fail to be a hit.

Among recent bands to record live from the stage of the Marquee club have been Rarebird, Byzantium, Gnidrolog, Status Quo, Rory Gallagher, Gas Works, Wishbone Ash and Tom Paxton. The Bradleys Road Show, with Hunter Muskett, Paul Brett and Kala ended their tour with a show at the Marquee a little while ago, and the tracks recorded then will be used in future albums. The session was engineered by Geoff Calver. Marquee expect future live performances to include those by Stackridge and Strider. Marquee tell me that the Rory Gallagher and Status Quo sets filmed and recorded there have now been accepted for general cinema release.

They also say that they have ordered an *MM1100* 24 track tape machine for delivery in the autumn. They recently accepted delivery of a new MCI 24 track console. Meanwhile, which sub-human specimen pinched Marquee's colour tv?

Anvil, Denham. Anvil have just taken delivery of their new Studer 16 track tape machine. Their first work with the new machine was in the preparation of an album of Norman Jewison's production of *Jesus Christ Superstar*. According to Anvil, this was a complicated operation which involved transferring over 30 35 mm tracks to 50 mm tape before the reduction to stereo on 6.25 mm tape. All the 35 mm tracks were Dolby encoded before the transfer to 16 track. 'The very considerable number of these 35 mm bands will tie up most of the motion picture equipment in Anvil's three theatres,' they said. 'It is doubtful whether any organisation in this country would have such a combination of 35 mm equipment coupled with 16 track recording and the necessary complement of Dolby units.' (I'll bet my phone doesn't stop ringing.)

Advision, London. As you might expect from one of London's busiest studios, there isn't room to report everything that's been going on: in the last couple of months they've worked on BBC documentaries, foreign language commercials, children's safety films, and film ads.

Album sessions include work by Jerry Lee Lewis, Jack Jones, Yes, Badger, Jonothan King, ELO, Darien Spirit and Rosetta Hightower.

Jerry Lee Lewis was working on a double album for Mercury. During the week the tracks took to record, he was backed by Albert Lee, Pete Gavin and Chas Hodges of Heads, Hands and Feet; Alvin Lee of Ten Years After; Pete Frampton; Matthew Fisher; Rory Gallagher; Delaney Bramlett; Kenny Jones of the Faces; singers Madeline Bell, Tony Burrows, Gary Taylor and Rossetta Hightower; and vocal group Thunderthighs. Martin Rushent engineered and Steve Rowlands produced the album, which included *Early Morning Rain*, *Memphis*, *Trouble in the Mind*, *Bad Moon Rising*, *Great Balls of Fire* and a medley of Little Richard standards.

Jack Jones's album, *Together*, has already been released and is the first complete album he has made in the UK. It was engineered by Roger Cameron. Badger's *One Live Badger* album was produced by Jeff Haslam and engineered by Martin Rushent.

The ELO album was called 'ELO 2' and included tracks such as *Roll Over Beethoven*, *In Old England Town* and *Mamma*. It was produced by Geoff Linn and engineered by Gary Martin.

More recently, Advision did some 16 mm work for the BBC, including a *Times Remembered* film on the life of Pascal, the film director, and a *Thirty Minute Theatre* film called *A Touch of Eastern Promise*.

Air, London. Bill Barringer of AIR tells me the film side are working on several productions at the moment: Dick Deadeye, for Bill Melendez Productions; transfer and recording work for *Live and Let Die*, scored by George Martin; a film of Leonard Cohen's recent European and Middle East tour which involved reductions from pulsed 16 track tape to triple 35 mm; and a short which will run before *Bequest to the Nation* called *Iron Village*, about life on HMS *Ark Royal*.

In the recording studios ELO, Yvonne Elliman, Richard Kerr, Mott the Hoople, Randy Stonehill and Stackridge are all making albums. T. Rex are overdubbing, Allan Clarke is making a single called *Nazareth* which is being produced by Roger Glover of Deep Purple, Elton John is producing Kiki Dee, and the Real Thing, Clay Hollister and Black Faith are all due to make albums.

The Kings Singers are in church again, I'm told, to record with Jack Cleggs new mobile recording unit. Other news is that AIR have been giving themselves a face-lift; Studio One has been repainted and there has been installed what William calls 'a flash new reception desk', the height of which appears to be such that 'if you peep over the top you might catch a glimpse of our new receptionist'. I may well bring my lifts out of mothballs.

Finally, an amazing new comedy duo recently made its debut at a night club in Positano, just outside Naples. They entertained a large group of engineers and recording and broadcasting executives and a few journalists who had all been taken to that part of Italy by 3M company to visit the company's plant at Casserta.

In the style of the old Las Vegas Clan, the pair, calling themselves the Davies Brothers, disported themselves upon the stage before a delighted, not to say drunk, audience. Information about the brothers is scarce: one of them, of indeterminate nationality, and chaperoned by a man who seemed to be known as 'Il Papa di Monty', clutched a bottle of what he fondly described as 'Vino Collapso'. A spokesman for the other has issued a statement from the cellar of his derelict Kosher tailor's shop in London's West End which says that the group will have to find a new manager before any further engagements can be contemplated.

ARP ODYSSEY AUDIO SYNTHESISER

By David Kirk

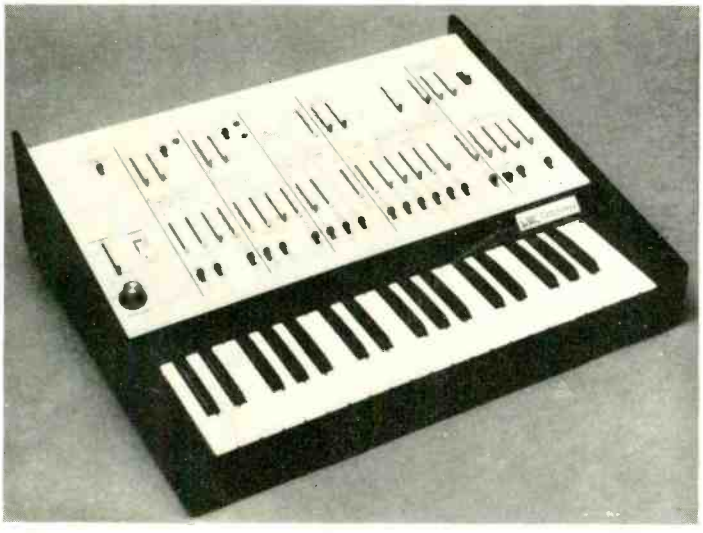


FIG. 1

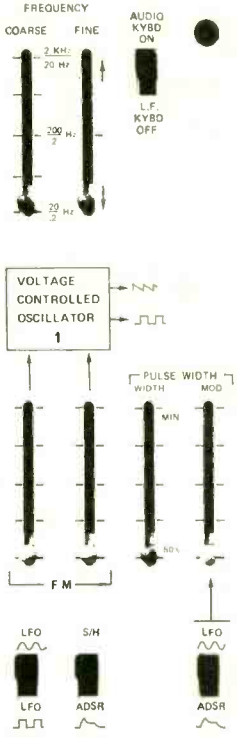


FIG. 2

MANUFACTURER'S SPECIFICATION

37 note two-voice keyboard. White/pink noise generator. Portamento speed, pitch bend sharp/flat, and keyboard transpose controls. Two vc oscillators. Oscillator sync switch. Lfo. Exclusive sample and hold circuit on mixer. Vc low-pass filter. High pass filter. Vc amplifier. Two envelope generators and keyboard-synchronised trigger repeat. Digital ring modulator. **Price:** £525+VAT.
Manufacturers: ARP Instruments Inc, Newton Highlands, Massachusetts, USA.
Agents: F. W. O. Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts. 953 0091.

RECIPE FOR an ARP *Odyssey*, for those who didn't read the specification: one variable-rate low frequency sine oscillator, two voltage controlled square/sawtooth oscillators, one sample/hold unit, one three input mono mixer, one voltage controlled filter, amplitude modulator and two envelope generators. Other basic ingredients are a three octave keyboard (C to C), an overall pitch bender and a portamento (sliding pitch) facility.

Routing between sections of the synthesiser is accomplished through two-position switches, each position marked with the selected signal source. There is no midway off point since a chosen source cannot be used until the corresponding slide fader is opened.

Fig. 1 shows the layout of the *Odyssey*, all processing and routing controls being located on a gently sloping light grey panel. This is overprinted in black, while the fader handles are coded in fairly logical groups of blue, green, yellow, pink, white, black and red. In terms of visual presentation, this is the neatest synthesiser I have yet come across.

Apart from the circuitry involved, and the little matter of pitch stability, the two main factors governing the choice of a synthesiser are (1) ease of operation, and (2) versatility. Item one tends to come at the expense of item two, and vice versa.

The *Odyssey* is clearly designed for on-stage performance where little time is available for adjusting control patches. One facility above all makes it the most literally musical synthesiser currently being marketed. Instead of being restricted to a single melody line, the keyboard will play two independent melodies simultaneously—a valuable step in the direction of polyphony. The highest note of any two pressed governs the pitch of oscillator Two, while the lowest of the pair governs oscillator One. If only a single note is pressed, then (if the initial tuning was appropriate) two unisons will be sounded.

I have been slow to realise it but expressions such as 'sample and hold', 'voltage control' and 'envelope generator' mean absolutely nothing to the average musician, even to the Pop boys who so loudly profess to be 'with it'. Most synthesiser makers endeavour to overcome this hurdle by supplying an instruction manual so large as to be nothing less than a book. More useful, perhaps, would be an initial change in terminology in the shape of temporary stick-on labels written in more easily digestible language. *Variable pitch source* over 'voltage controlled oscillator', *low pitch signal* over 'low frequency oscillator', *random signal source* over 'sample and hold', *pure hiss* over 'white noise', *pink hiss* over 'pink noise', *timbre shaper* over 'voltage controlled filter' and *loudness shaper* over 'envelope generator'. In Tom Onions' world, envelope generators make paper packets.

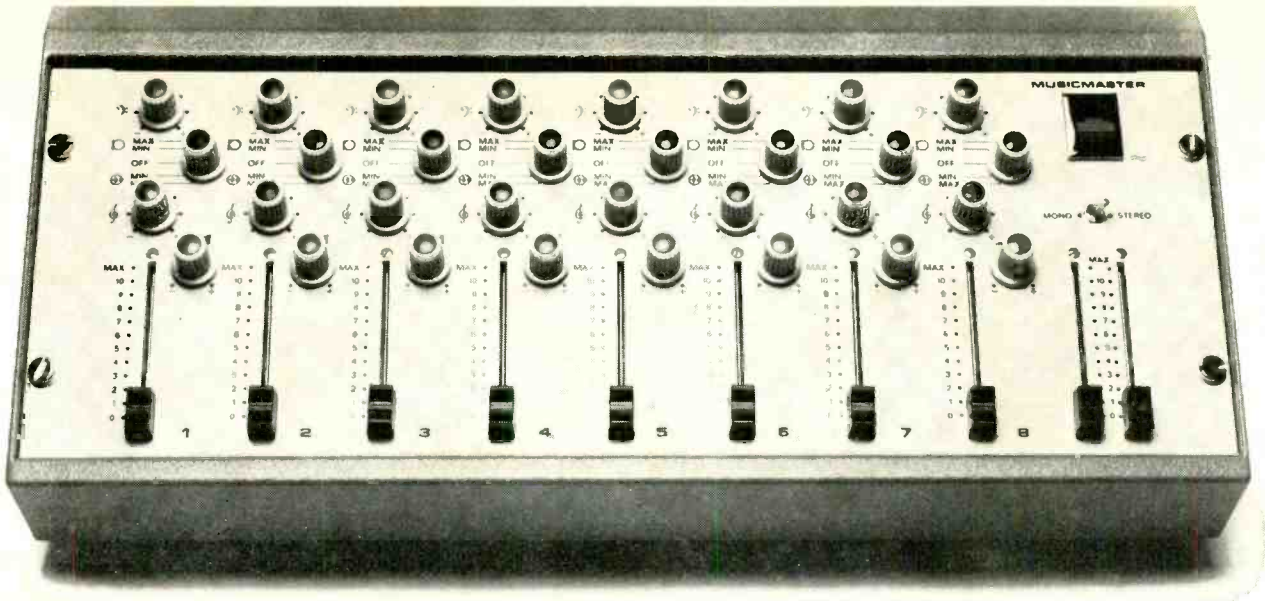
The foregoing is a serious suggestion though imaginative designers might find more appropriate non-jargon than the terms I have named. The point applies equally to all synthesiser manufacturers and is not aimed at the *Odyssey* in particular.

Fig. 2 provides a close-up view of the vco One panel. Initial pitch is set by coarse and fine slide controls at the top left. Right of these is a switch from the keyboard pitch control voltage. Switched on, the control causes the oscillator to rise and fall in pitch according to the lowest note played on the keyboard. The keyboard is tuned to produce exactly one semitone pitch change with every semitone rise and fall along the keyboard.

When the keyboard is switched off, oscillator One is set to a low frequency range. Pitch may still be preset by the coarse and fine sliders or frequency modulated through the 'fm' sliders on the lower left of the panel. The switch in the bottom left corner routes either a sine or square wave voltage to the oscillator One pitch control, modulating only when the slider is opened. 'Lfo' refers to the low frequency oscillator in the centre of the *Odyssey* panel.

Right of this switch is another, routing a pitch modulating signal from the sample and hold generator or the adsr envelope generator. The sample and hold setting may be employed for random pitch modulation comparable with a chimpanzee at the keyboard. Every few million years it may play the *1812* but for the rest of the time its output will be almost

42 ▶



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VITAVOX

entirely original. In the adsr switch setting, the oscillator can be pitch modulated by the same waveform governing the dynamic envelope. Typically a sharp rise and slow fall in pitch corresponding with a short attack and long delay time.

In the right-hand corner of oscillator One, an lfo-sine/adsr source selector allowing pulse width modulation of the square wave signal. Initial pulse width and modulation degree may be preset by the independent sliders above the switch.

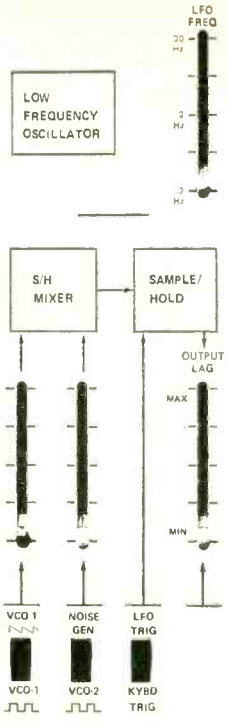
Oscillator Two is identical to oscillator One save in the wiring of two switches. The top right switch (**fig. 3**) allows this oscillator to be phase locked to oscillator One, at the expense of the polyphonic facility. It might be said of musical physics that nature abhors a phase lock though in practice the sync setting has considerable artistic potential. If oscillator One is set to a convenient mid frequency and oscillator Two adjusted in sync with it, a harmonic series can be heard when the oscillator Two pitch is varied. When the keyboard is played in this mode, the lowest note pressed determines the pitch while the highest of any two notes controls the harmonic content.

The other departure from oscillator One: the down position of the bottom left fm source selector connects to either the sample and hold mixer or a plug-in pedal voltage control.

In **fig. 4**, two sub-panels form the middle section of the *Odyssey* control grouping. Topmost is a slider governing the low frequency oscillator rate. This is adjustable from 0.2 to about 10 Hz and supplies sine or square waves to some of the route switches adjacent to the keyboard. In addition to providing a pitch modulation source, the lfo can be switched to govern the switching speed of the sample and hold generator occupying the lower panel section.

If the middle slider in the bottom row of **fig. 4** is raised, the s/h section will sample either noise or an oscillator Two square wave. 'Sampling' is here defined as freezing the momentary level of a signal until the next sample is taken. Noise sampled in this manner gives an endless chain of random-level voltage plateaux which, routed to an oscillator pitch control, produces the chimpanzee effect described earlier.

FIG. 4



Any of the following additional signals and combinations may be sampled to vary the pitch of an oscillator and/or the top cutoff frequency of a voltage controlled low-pass oscillator: tri-One (triangular wave from oscillator One), square-One, tri-One plus noise, square-One plus noise, square-Two, tri-One plus square-Two, or square-One plus square-Two. Since the combination proportions and relative pitches may all be varied, let alone the sampling rate, the result is a wide variety of incoming signals. An output lag slider permits a progressive sloping of the otherwise instantaneous voltage change between samples. This introduces a portamento when used for pitch control. It also 'de-clicks' an s/h signal used to modulate the filter cut-off point.

It is possible to disconnect the low frequency oscillator from the s/h generator by pushing down the lower right-hand switch from 'lfo trig' to 'keyboard trig'. In the latter setting, a sample is frozen each time a key is pressed—allowing a more or less random melody to be played on a single key.

Fig. 5 shows the mixer and filter sections combined on a single large panel group. Quibbling time. Why are the low pass and resonance filter controls adjacent to the mixer labelling rather than further right? Perhaps to prevent the lfo slider from seeming too isolated. Being stupid, I several times found myself operating the 'lfo freq' control when I had meant to work the 'vcf freq'.

Of the seven sliders in the lower part of **fig. 5**, the leftmost three are mixer input faders. There are six signal sources, being noise, tri-One and tri-Two (all switches up); ring modulator, square-One and square-Two (all switches down). What, you may ask, does the ring modulator modulate? Though there are no markings to say so: square-One and square-Two, regardless of the adjacent switch positions. Used in conjunction with the pulse width modulator, the ring modulation facility has considerable practical musical value.

Shifting attention to the filter, a further three switches and sliders provide six signals capable of modulating independently or in combination —the turnoff frequency of a low-pass filter. The *Odyssey* filter has three presettable parrameters—controlled via the top row of sliders. 'Vcf freq' presets the initial turnoff frequency of the low pass network. 'Vcf resonance' determines the height of a resonart peak just before (and permanently locked to) the turnoff frequency. Lastly. 'Hpf cutoff" behaves as a plain high pass cutoff frequency control.

For normal musical applications, the keyboard control voltage (fourth switch from left) is routed to the filter to shape the harmonic content of each note without cutting off high fundamentals. The keyboard may be switched out in favour of pedal filter control, giving the effect (a shade over-used these days) of a 'wah-wah' pedal.

If the attack-release or more versatile attack-decay-sustain-release generator is switched in to modulate the filter, the harmonic structure varies during the life cycle of each note.

Farthest right of the Odyssey are the two envelope generators (**fig. 6**) which influence the

FIG. 5

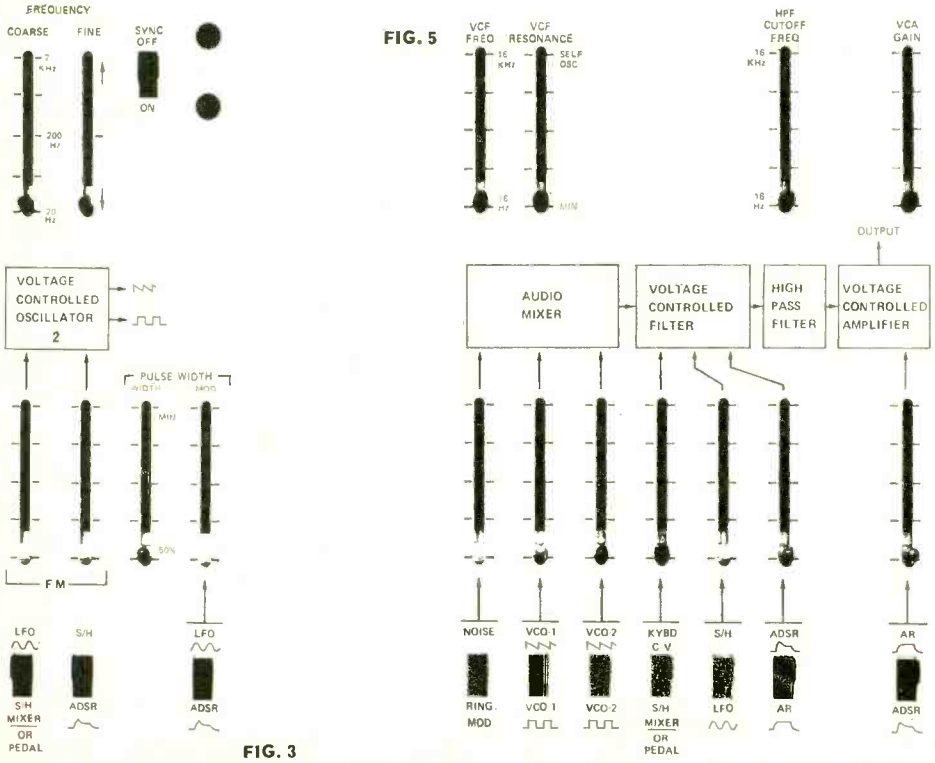
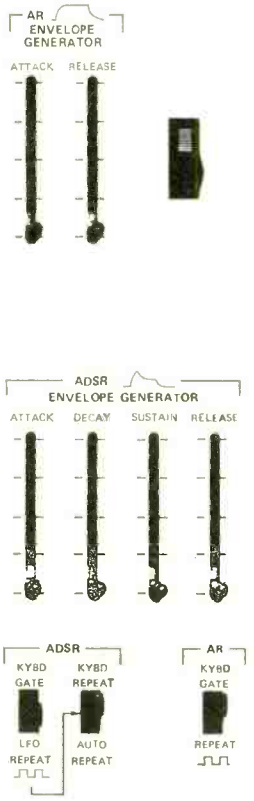


FIG. 3

filter and voltage controlled amplifier in the preceding panel. Why two such generators? Essentially to provide separate dynamic and filtration characteristics though the adsr envelope may also be used for oscillator frequency modulation. The attack-release function should need no explanation, each parameter being controlled by one of the two sliders by the neon illuminated mains switch. Attack and decay times are each variable to a maximum of 5s. Sustain level is independent of these two controls, being determined by the vca slider on the lower right of **fig. 5.**

Returning to **fig. 6,** the adsr generator provides independent control of attack time, and *initial* decay time, leaving two further sliders to determine sustain level and final decay ('release') time. In a normal performance, the

FIG. 6



ar and adsr would probably be triggered from the keyboard though each can be triggered by the low frequency oscillator if a rapid-pluck effect is desired or if the synthesiser is to play independently of the keyboard.

Other details. A portamento on-off footswitch came with the instrument and, like all other peripherals, connects at the rear. Three 6.25 mm jack sockets and one phono socket respectively connect pedal, portamento footswitch, low and high level audio. A 2m earthed mains cord is fitted though the green/black/white coding might dispatch anyone unfamiliar with American wiring colours.

Excellent workmanship, logical design, elegant presentation and a reasonably low price of £525 (plus VAT). The *Odyssey* has no apparent vices and is unreservedly recommended to stage musicians and studios requiring an inexpensive basic synthesiser.

VIDEO

hard oxide like the Sony *V32* will reduce the tendency to clog but with some decrease in the life of metal heads like those used in the *SV700.* Otherwise the ferrite heads used in most modern vtrs have such good wearing properties that head life is no longer a major factor. The cleaning of clogged heads is best done with a freon aerosol spray, such as *A-F;* this seems to leave no deposit on the tape and a clogged head on playback can usually be cleared without stopping the machine by spraying between the tape and drum.

FIG. 2A

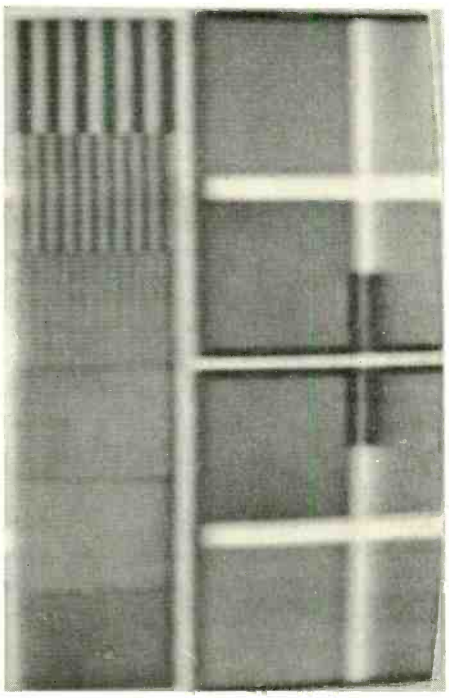
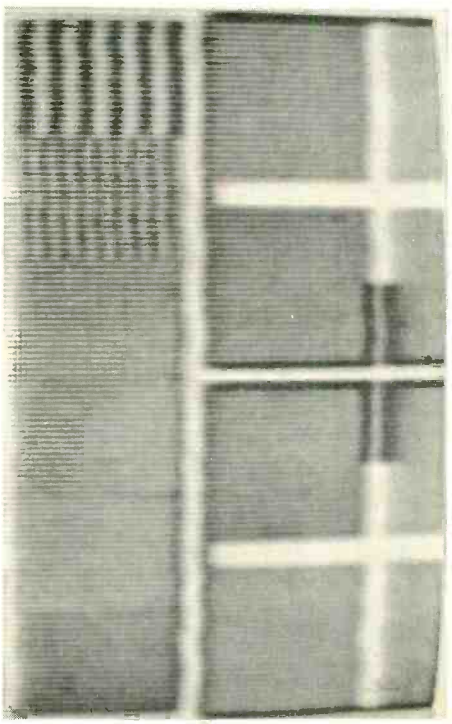


FIG. 2B



Dropouts show up most easily if sections of mid-grey or black are recorded on to different parts of the tape.

There are several methods of measuring noise; this is a function of the machine type, the particular heads used, and finally the tape. Recording unmodulated carrier only, the record current was adjusted for maximum rf output from the head amplifier on playback in our tests and the video noise measured with an rms voltmeter and compared with the peak value of the video signal without syncs. The annoyance value of a record/replay system can be roughly gauged by viewing normal recordings with the monitor contrast increased.

The time base stability is best judged by inspecting the vertical edges of a test-card. **Fig. 2a** and **b** show sections of good and poor samples respectively.

Conclusions

The lesson to be learned from the experiences with tapes *A* and *B* described earlier is that tape problems may not show up immediately on a sample reel. If the sample is good, try half a dozen reels; if they are consistent it is worth risking the purchase of ten or 20 more. Only after this can one safely call a video tape reliable.

The four tapes tested above should not be taken as the last word on the subject as the market changes very quickly and the tape used plays such an important and expensive part in the video chain that it warrants the most careful consideration by the serious user.

The following companies market video tape in the UK in 12.5 mm widths: Agfa-Gevaert, Ampex, BASF, EMI, Memorex, Philips, 3M, Shibaden, Sony and Racal-Zonal. A useful guide to current video tapes, with prices, is printed on the back of the Factsheets available from Studio 99 Video Ltd, 73 to 81 Fairfax Road, Swiss Cottage, London NW6.

Appendix to April 'Video'

Further reading on the subject of low-light television:

'Developments in television camera tubes', Pay and Turk.
The Royal Television Society Journal Vol 11 Autumn 1967.

'Silicon diode-array tubes and targets', Woolgar and Bennett.
RTS Journal Vol 13 No 3 May-June 1970. (The above and other useful reprints are available from the English Electric Valve Co, Chelmsford, Essex.)

'Camera tubes for night vision', *Optical Spectra* February 1971.
A reprint of this together with other relevant information was supplied by J. D. Jackson Electronics of Nottingham.

Finally, credit is due to Colin Crook (chief technician of the Social Psychology Laboratory at the University of Sussex) for the use of test equipment in preparing the article.

Survey: Audio delay units and reverberation generators

AKG

Manufacturers: AKG Akustische U. Kinogerate GmbH, 1150 Wien, Nobilgasse 50, Austria.

Agents: AKG Equipment Ltd, 182/4 Campden Hill Road, Kensington, London W8 7AS.
Tel. 01 229 3695

BX20
Technical specification

Input level: +6 dBm (1.55V).
Maximum permissible level: 12 +dBm (3.1V).
Output level average: +6 dBm (1.55V).
Input impedance: more than 2k ohms symm per system (more than 1k ohms at parallel switch).
Output impedance: less than 50 ohms symm.
Reverberation decay time: continuously variable from 2 to 4.5s per channel separately.
Level difference between channels: maximum 3 dB (depending on reverberation time).
Signal-to-noise ratio in relation to +6 dBm —69 dB.
Unweighted signal-to-noise ratio in relation to +6 dBm: —56 dB eff.
Frequency range: 20 Hz to 12 kHz.
Frequency response: 20 Hz to 8 kHz at a band width of ±5 dB from standard curve. Measured with pink noise at input, the output signal being recorded in thirds.
Insertion loss measured with 1/3 octave noise: at 1 kHz; 0 dB at input; 3 dB maximum at output.
Channel separation: more than 60 dB (valued according to DIN 45405 eff).
Acoustic feedback safety: more than 100 dB, ie the faded sound level in the close proximity of the instrument may amount to 100 dB spl before any acoustic feedback sets in.
Elastic suspension: natural resonance of the suspension: less than 1 Hz, usual shock does not produce disturbing effects, periodic vibrations of low frequency should be avoided.
Power supply: 220V/110V AC, 40 to 60 Hz, or 24V (22V-30V), 0.5A fuse.
Power consumption: 12 VA.
External dimensions: 43 x 50 x 110 cm.
Weight: 50 kg approx.
Maximum permissible inclination of the unit measured at the housing: less than 1.5° from the vertical.
Price: £1075 plus VAT.

EAGLE

Manufacturers: Eagle (Japan).

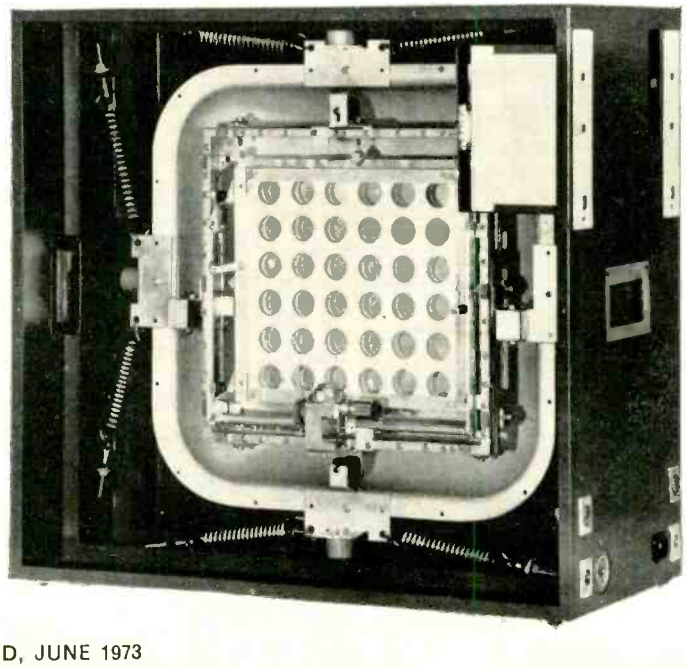
Agents: Eagle International, Precision Centre, Heather Park Drive, Wembley, HA0 1SU.
Tel. 01 903 0144.

RA 856 REVERBERATION AMPLIFIER

Self - contained battery - operated transistorised reverberation amplifier—'gives extra richness' to one-dimensional sound from a single source. Controls to adjust volume and reverberation. Microphone plugs into RA 856 and output is plugged into the amplifier. Walnut cabinet.
Input: 5 mV at 10k ohms.
Output: variable 0 to 600 mV.
Delay: variable 20 to 30 ms.
Dimensions: 190 x 75 x 110 mm.
Price: £12.60 plus VAT.

RA 859 TWO CHANNEL REVERBERATION AMPLIFIER

A mains operated two-channel reverberation/mixer unit with two microphone and two instrument inputs. As well as depth of reverb, separate mic and instrument controls allow mix and fade effects. The unit has a leather grain PVC covered cabinet and a sloped front control panel.
Mic inputs: two at 600 ohms.
Instrument inputs: two at 100k ohms.
Output: 500 mV at 100k ohms.
Delay: variable 20 to 30 ms.
Dimensions: 300 x 88 x 170 mm.
Price: £18.69 plus VAT.



Adjacent: EMT *240*
Above: AKG *BX20* control unit
Low right: Eagle *856*
High right: Eagle *859*

EMT

Manufacturers: Elektromesstechnik Wilhelm Franz KG, D-6730 Lahr/Schwarzwald, Postfach 1520, Germany.

Agents: F. W. O. Bauch Ltd, 49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ.
Tel. 01 953 0091.

140 TS

The new version of the EMT 140 carries the designation EMT 140 TS and with built-in remote control EMT 140 FB-TS.

The frequency response of the reverberation time without additional damping, corresponds approximately to that of an empty stone walled hall or church; ie about 5s at 500 Hz. Towards the low frequency end there is a rise and towards the high frequency end a decline (to about 1.5s at 10 kHz), just as is the case in actual rooms as a result of the sound absorption of the air.

The EMT 140 TS reverberation unit uses the physical torsional properties of metals to achieve its effect.

Its main component is a steel plate which is suspended in a tubular steel frame. Parallel to this

plate, another made of highly porous material is suspended in such a way as to permit it to be swung towards or away from the steel plate with an extreme distance ratio of about 1:30. This motion is controlled by means of a hand wheel, or it may be remote-controlled from the studio console itself and the particular reverberation time remotely indicated by an appropriate meter.

The steel tube frame which carries the steel plate has three transverse bridges, of which one mounts the magnet for the moving coil excitation system, while the other two are used for the two contact microphones and their connecting wires. The frame furthermore has the bearings for the damping plate arms mounting at the top and bottom, and is suspended by means of rubber shock mounts from the outside frame. Should the reverberation unit be exposed in its location to extreme mechanical noise interference, it can be further isolated by additional elastic suspension of the unit itself.

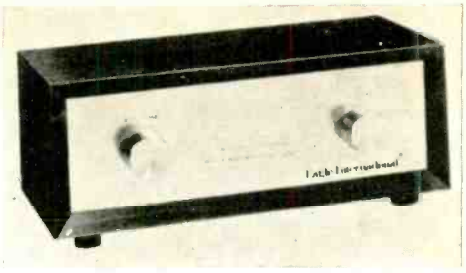
The reverberation plate together with its drive and reproduce amplifiers is built into a massive wood case. The standard version has a hand wheel for the adjustment of reverberation time. The remote control components may be obtained and installed at a later time. The installation time required is, however, considerable and it is therefore recommended that the choice of remote control or manual control be made prior to the ordering of the unit.

When the damping plate, which is constructed of absorptive material, is brought closer to the steel plate, its bending oscillations are increasingly damped and a shortening of the reverberation time results. This damping plate is so constructed as to be perfectly flat in spite of its great surface area and can therefore be brought to a distance of about 3mm from the steel plate without touching the same. The minimum reverberation time reached at this distance is approximately 1s at 500 Hz.

Besides the standard model, the EMT *140 TS* reverberation unit is also available with remote control facilities. This is done by means of a motor built into the unit itself by means of which the damping plate distance from the steel plate may be continuously varied.

Technical specification

Reverberation time (re 500 Hz): 1 to 4s.
Time scale accuracy (re 500 Hz): ±8 per cent.
Weighted and unweighted noise levels measured at T=2s.
Unweighted noise level (with remote control running): less than —50 dB.
Peak weighted noise level: less than —60 dB.
Input level for full drive: +1 dBm min.
Input impedance: more than 5k ohms.
Output level for full drive: maximum +12 dBm.
Output of amplifier: maximum +24 dBm.
Output source impedance: less than 25 ohms.
Load impedance: more than 200 ohms.
Ac power requirement: 100/220V 50 Hz 117V 60 Hz, maximum 60 VA.
Remote control for model EMT *140 FBTS* with built-in servo motor, relay control and reverb time instrument:
External power required: 24V/0.25A.
Weight:
without remote control: 170 kg.
with remote control: 190 kg.
Dimensions: 2.4 x 0.34 x 1.3m.
Ordering information
Stereo reverberation unit: manual control EMT 140 TS, remote control EMT 140 FB-TS.
Remote control panel alone: EMT 140B, amplifier alone: EMT 162 TS.
Price: EMT *140TB* £1,607; EMT *140FBTS* £2,047; EMT *140Q* £2,205; EMT *140T* £16.90; EMT *140B* £41.90; EMT *162 TS* £365.
Note: Prices do not include VAT.



140Q

The 140Q is a four channel version of the stereo EMT plate. It has four inputs. These pass through two stereo amplifiers, after which they are mixed down to mono. The resulting signal excites the plate. There are four pickup transducers on the plate to give a signal for each channel. The signals from the transducers are amplified and passed to the outputs.

Technical specification

Inputs: four, symmetrical.
Input impedance: at least 5k ohms.
Outputs: four, symmetrical.
Output impedance: 25 ohms maximum.
Reverberation time at 500 Hz: adjustable 1 to 4s.
Noise:
With reverb time set at 2s: —50 dB maximum.
With remote control running: —38 dB maximum.
Weighted noise:
Reverberation time at 2s: —60 dB maximum.
Weight: 180 kg.
Dimensions: 240 x 34 x 132 cm.
Price: £2205 plus VAT.

240

Smaller version of the EMT 140, having one fifth the volume of the 140.

Technical specification

Reverberation time at 500 Hz: 1 to 4s.
Density of resonances: greater than 3 Hz.
Maximum ambient noise level: 80 phon maximum
Maximum dimensions: 63 x 67 x 30 cm.
Maximum weight: 60 kg.
Amplifier:
Frequency response from 40 Hz to 15 kHz relative to standard curve: ±2 dB.
Total harmonic distortion at 1 kHz and maximum output: 0.5 per cent maximum.
Signal-to-noise ratio (unweighted): at least 60 dB.
Input: balanced and floating.
Impedance: at least 5k ohms.
Maximum input signal: ±21 dB.
Output: balanced and floating; impedance: 30 ohms.
Maximum output signal: +21 dB.
Specifications subject to change without notice.
Price: EMT *240* £1680 plus VAT; EMT *240 B* £41.90 plus VAT.

440 DELAY SYSTEM

The input voltage is chopped by a pulse frequency of 30 kHz. Each resulting section is analysed for its amplitude in a high resolution comparator. It is ascertained in ten steps whether the amplitude lies above or below half the reference value, thereby resulting ten yes/no informations at 2^{10}=1024 possibilities; these are given out as a nine bit digital code. The nine outputs are now fed parallel to the actual delay store, which consists of nine integrated dynamic metal-oxide (MOS)—shifting registers. Each of these contains over 1000 storage positions behind each other, which can be regarded as flip-flops, via which the information is advanced at a frequency of 30 kHz. An output is available after each 250 positions, so that there are four outputs each of 7.5 ms duration comprising a total duration of 30 ms. A step switch activates a multiple gate circuit, which places a digital analogue transducer on one of the outputs and delivers a reconverted, delayed, analogue output signal.

The above mentioned nine-bit language does not alone give satisfactory quality. The quoted amplitude resolution is therefore raised to a total of about 2000 steps by a switchable scale factor, whereby a digital pilot-signal control identifies the respective switch position. This produces the function of an 11 bit-language, which ideally fills the demands of studio techniques.

Technical data

Delay time: in steps of 7.5 ms switchable according to components from 0-30, 60, 90 or 120 ms.
Sampling frequency: 30 kHz.
Amplitude quantisation: quasi- 11 bit.
Input:
Nominal voltage: +6 dB.
Input impedance: more than 10k ohms.
Output:
Nominal voltage: +6 dB.
Output impedance: less than 40 ohms.
Frequency response: 40 Hz-12 kHz, —3 dB.
Unweighted signal-to-noise ratio referred to +6 dB: 70 dB rms.
Signal-to-noise ratio referred to +6 dB weighted according to DIN 45 405: 66 dB peak.
Distortion:
at +6 dB, 100 Hz: 0.3 per cent max.
at —14 dB, 100 Hz: 0.3 per cent max.
at —34 dB, 100 Hz: 1 per cent max.
at +6 dB, 1 kHz: 0.3 per cent max.
at —14 dB, 1 kHz: 0.3 per cent max.
at —34 dB, 1 kHz: 1 per cent max.
at +6 dB, 5 kHz:
at —14 dB, 5 kHz: 0.3 per cent max.
at —34 dB, 5 kHz: 1 per cent max.
Pre- and de-emphasis: 75 µs.
Price: EMT *440* 120 ms £2970 plus VAT; EMT *440* 60 ms £1840 plus VAT.

EVENTIDE

Agents: Feldon Audio Ltd, 126 Great Portland Street, London W1.
Tel. 01 580 4314

MODEL 1745

The basic unit, with 200 ms of delay and two switchable outputs is sufficient for most normal applications. The addition of optional delay modules can bring the system compatibility up to 800 ms and an unlimited number of outputs.
Technical specification
Frequency response: 20 Hz to 15 kHz ±1 dB.

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SURVEY

Dynamic range: greater than 66 dB (front panel lamp indicates an overload).
Distortion: less than 1 per cent at 1 kHz, referred to the output level.
Input impedance: 10k ohms.
Input maximum level for microphone dynamic range: —8 to +8 dBm adjustable.
Output impedance: 50 ohms, suitable for driving 300 ohms or higher.
Output level: adjustable +8 +4 or 0 dBm referred to the output level.
Power requirements: 115 or 240V ac, 50 to 60 Hz.
Dimensions: standard 483 mm rack, 136 mm high, by 305 mm deep.
Price: £1,980 plus VAT.

GOTHAM

Manufacturers: Gotham Audio Corporation (USA).

Agents: F. W. O. Bauch Ltd, 49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ.
Tel. 01 953 0091

DELTA-T 101

The control of the parameter time in the field of high quality audio until now has been restricted to the use of magnetic storage media such as tape loops and magnetic discs. The shortcomings of such systems are numerous: the fragility of the magnetic carrier leading to breakage and failure, the excessive flutter content of the delayed signals, the inherent distortion of the medium and the service problems which come from all mechanical, moving systems. The Gotham *Delta-T 101* digital audio delay system is the first all-electronic audio time delay device ever marketed. There are no mechanical moving parts.

The device, in essence, converts the analogue audio information into digital form, stores it in this state and retrieves it at some later time controlled by switches on the front panel. Since there can be no degradation of the digital data while in storage, the delayed outputs maintain identical signal quality for all settings of the delay selector switches.

The *Delta-T 101* is available in its minimum configuration as a single channel device, with the amount of time delay selectable in 5 ms steps up to a maximum of 40 ms. Additional plug-in output steps up to a maximum of five, may be added at any time. Each of these will have its independent delay selection switches as well as a by-pass switch. Seven additional delay cards of 40 ms each may also be plugged into the *101*'s frame to bring the unit up to its maximum 320 ms delay capability. The delay selector switches on each output unit are always provided with the full 320 ms range, and therefore prepared for a full delay complement.

Technical specification

Frequency response: 20 Hz to 12 kHz ±2 dB.
Total harmonic distortion: less than 1 per cent at +22 dBm output level.
Input signal dynamic range: 60 dB, referenced to output quantisaton level.
Input sensitivity: —6 dBm to +14 dBm produces +4 dBm at output (adjustable).
Input impedance: 27k ohms; balanced and floating.
Inputs: one.
Outputs: up to five plug-in output units each separately settable to any delay time.
Time delay: adjustable in 5 ms steps up to 40 ms for minimum delay configuration. May be extended in 40 ms plug-in card increments to a maximum of 320 ms delay.
Accuracy of time delay: better than 0.01 per cent of indicated delay.
Output impedance: less than 60 ohms. Designed to work into 600 ohms load.
Wow and flutter: 0 per cent.
Power requirement: switchable 115/230V (100-240V) 50/60 Hz: 90 VA max.
Size: standard 483 mm rack panel, 180 mm high and 416 mm behind panel.
Weight: approx. 18 kg.
Controls: power switch, fuse holder and power pilot on front panel. Limit light indicates when limit of internal dynamic range has been reached. Acts as instantaneous action clipper above that point. Each output module equipped with two rotary selector switches: one in 5 ms steps to 40 ms, the other in 40 ms steps to 280 ms for total of 320 ms. Each output module equipped with rocker switch to permit switching the time delay in or out. Remote limit light (max. 15V 80 mA) may be connected through rear connector.
Price: *101* basic unit less memory or outputs: £1033 plus VAT, *1011* plug-in output module (5 maximum) adjustable delay time £153 plus VAT, *1012* as above, but fixed dealy £153 plus VAT, *SDD-1* 40 ms delay cards (eight maximum) £268 plus VAT.
Note: minimum system (40 ms, 1 output) £1454 plus VAT, maximum system (320 ms, 5 outputs) £3942 plus VAT.

GRAMPIAN

Manufacturers: Grampian Reproducers Ltd, Hanworth Trading Estate, Feltham, Middlesex TW13 6EJ.
Tel. 01 894 9141.

REVERBERATION UNIT

This instrument, intended for either amateur or professional use, employs a pair of mechanical (spring) delay lines with electro-magnetic transducers to simulate the reverberant effect of a 'live' hall. The total reverberation time (defined as the time taken for a sound to die away to one millionth of its original intensity) at 300 Hz is greater than 2s.

There are two signal paths through the instrument, a direct path via which the unmodified signal reaches the output, and the reverberation path described above, which embodies a separate gain or 'reverberation' control. This enables the ratio of reverberant to direct sound to be varied from zero to approximately 1/1. A muting switch may also be connected in the reverberation path.

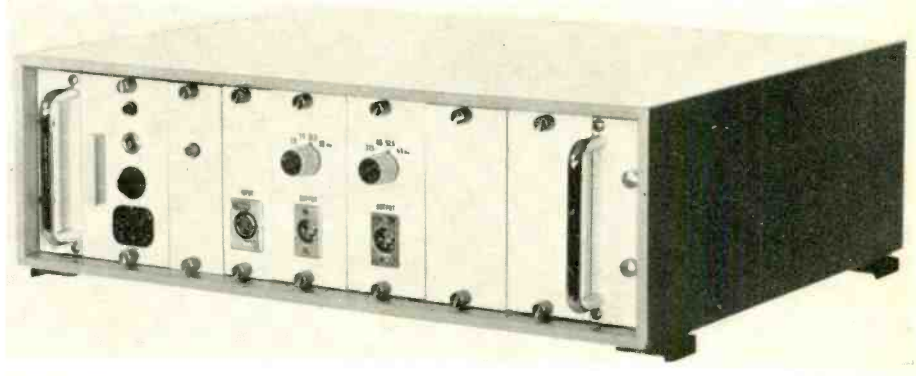
Two independent input channels are provided; a low level channel specifically intended for low impedance moving coil or ribbon microphones, and a low or high level, high impedance channel which can accept signals from guitar pick-ups, crystal gramophone pick-ups, tape pre-amplifiers etc, or from a bridging connection to a 600 ohms line.

The single microphone channel is arranged to accept either a balanced or unbalanced input connection, and embodies a novel variable negative feedback circuit which will accept the very large input signals associated with close microphone technique without danger of overloading the associated preamplifier. The output of the unit is 300 mV across 600 ohms impedance, and may be fed through long lines with very little high frequency loss.

An indicator lamp serves as a combined overload indicator and protective device.

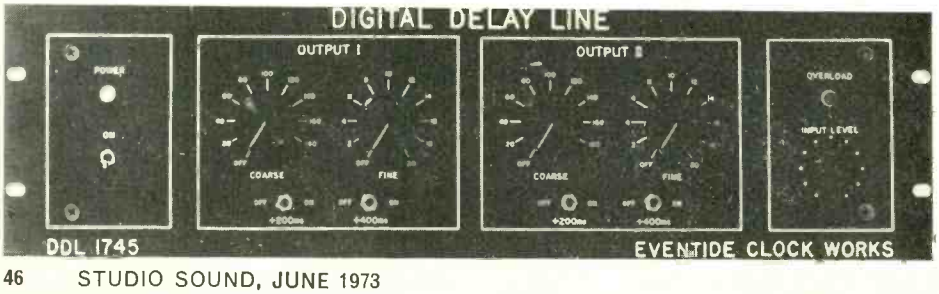
Power supplies for the unit are derived from two nine volt dry batteries thereby eliminating mains borne interference earth 'loop' problems, and other sources of hum and making the apparatus portable.

It should be stressed that this instrument is intended to be used for improving the quality of recorded music and vocals especially when recording takes place under abnormally 'dead' acoustic conditions: and for dramatic effects—it is not intended to provide the 'flutter-echo' effect associated with electric guitars on 'pop' music recordings.



Gotham *101*

Eventide *1745*



Technical specification

Inputs: two independently controlled input channels are provided, one for 25 ohm microphones and the other for high impedance signals.
Microphone channel:
Connection: balanced or unbalanced.
Matching impedance: 25 ohms (600 ohms to order).

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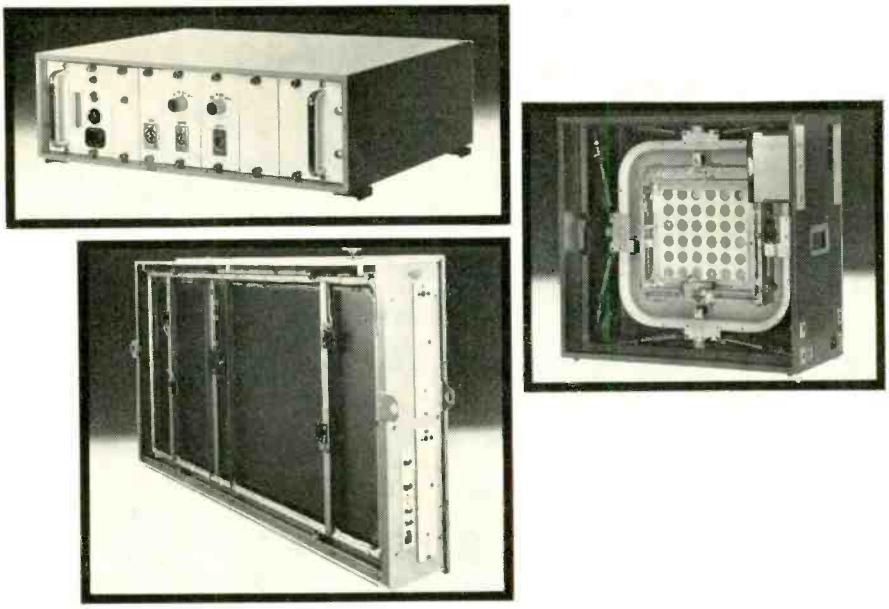


EMT

F.W.O. Bauch Limited
49 Theobald Street
Boreham Wood Herts
Tel: 01-953 0091

Electronic Delay EMT 440 | Gold Foil Reverberation EMT 240

Quad Reverberation EMT 140Q

Sensitivity: 20 μV across 25 ohms.
Auxiliary channel:
Connection: unbalanced.
Matching impedance: (a) 50k ohms (b) 1V ohms.
Sensitivity: (a) 10 mV (b) 500 mV.
Output:
Connection: unbalanced.
Source impedance: 600 ohms.
Program level: —8 dBm (300 mV).
Maximum level: 1V (+2 dB).
Frequency response: ±2 dB 35 Hz to 20 kHz on all inputs.
Noise: both channels closed, —68 dBm at output, reverb fully on.
Reverberation path:
Delay times: 29 and 37 μs nominal.
Reverberation time: 2s at 300 Hz.
Frequency response: ±3 dB 100 Hz to 6 kHz.
Direct/Reverb ratio: 1/1 maximum.
Overload indicator: 6.5V 1W les panel lamp.
Remote switch: mutes reverberation, connection via standard jack socket, isolated from earth.
Power supply: two 9V batteries, Ever Ready *PP9* or equivalent IEC spec 6F100 (batteries extra).
Consumption: 50 mA average on speech and music.

Controls: three rotary controls for mic gain, aux gain reverberation, together with overload indicator lamp, and on/off switch, mounted on vertical front panel.
Connections: six standard jack sockets grouped in pairs on top of the instrument.
Size: 444 x 133 x 158 mm.
Weight: 5.4 kg complete with batteries and lid.
Finish: grey vynide-covered wooden carrying case with detachable lid. Panel finish satin silver and eggshell black. A power pack to operate the unit from 200/250V ac mains is also available.

'AMBIOPHONIC' UNIT 666

This unit is manufactured for two specific uses:
1. To increase artificially the reverberation times of listening rooms, small auditoria, etc. by feeding reverberated signals to a number of small loudspeakers distributed around the listening area.
2. To be used in conjunction with a professional sound mixing console to provide an artificial reverberation facility, on monophonic or stereophonic systems.

The reverberation device used in the unit is the same as that used in the well known Grampian type *636* reverberation unit, but the Ambiophonic unit has no direct signal path. It has two high impedance line-bridging input connections, suitable for connection to the loudspeaker circuits of sound reproducing equipment. The signals from these inputs are mixed and fed via the level control to the reverberation spring driver amplifier, which incorporates an overload indicator lamp. The output from the reverberation springs is connected to a 3W push-pull power amplifier which feeds the ambiophonic loudspeakers, and provides two zero-level 600 ohms outputs for professional use.

The unit is fitted with an aluminium case, with satin finished front panel; it is primarily intended for mounting in a console or equipment cabinet.

Technical specification

Inputs:
Connection: twin, unbalanced via standard five pin DIN socket.
Terminal impedance: 10k ohms (for 600 ohms bridging connection).
Sensitivity: —2 dBm (approx. 600 mV) from either line for rated output (other input terminated in 600 ohms).
Output:
Loudspeaker:
Connection: terminal strip, one side earthy.
Load impedance: minimum 5 ohms (eg 3 x 15 ohm loudspeakers in parallel).
Maximum power: 3W rms into 5 ohms at 1 kHz with 5 per cent thd from 220V mains.
600 ohm lines: (loudspeaker output not used).
Connection: twin, unbalanced, via standard 5 pin DIN socket.
Source impedance: 600 ohms resistive.
Rated output level: 0 dBm (0.775V) on each line.
Maximum output level: +10 dBm (2.5V) on each line.
Distortion: less than 1 per cent thd in amplifier at rated output level.
Gain:
Overall voltage gain: +2 dBm at 600 ohms output.
Overload indicator: tungsten lamp set to glow at rated output on sine wave drive.
Noise: less than —45 dB at either 600 ohms output.
Reverberation characteristics:
Frequency response: 100 Hz to 6 kHz nominal.
Delay times: 29 and 37 ms nominal.
Reverberation time: 2s at 300 Hz, 1.5s at 3 kHz.
Power supply:
Connection: 2m three-core lead permanently attached at rear of unit.
Mains voltage: 100 to 125V, 200 to 250V ac 40 to 60 Hz.
Consumption: 8 VA.
Controls: numerically calibrated rotary level control, mains switch.
Operating temperature: 0°-50°C ambient.
Size: overall 46 x 12 x 13.5 cm.
Weight: 3.2 kg.
Panel finish: satin aluminium with black lettering.

Plugs supplied: one DIN five pin (McMurdo type trp4).

SHURE

Manufacturers: Shure Electronics (USA)
Agents: Shure Electronics, 84 Blackfriars Road, London SE1 8HA.
Tel. 01 928 3424.

M68 RM2E

The *M68 RM2E* is a 240V ac version of the standard Shure microphone mixer with built in reverberation on all four channels and a master reverb intensity control. The unit uses two springs of different stiffnesses. The reverberation time of the unit is not specified.
Price: £63.60 plus VAT.

VA302E-C

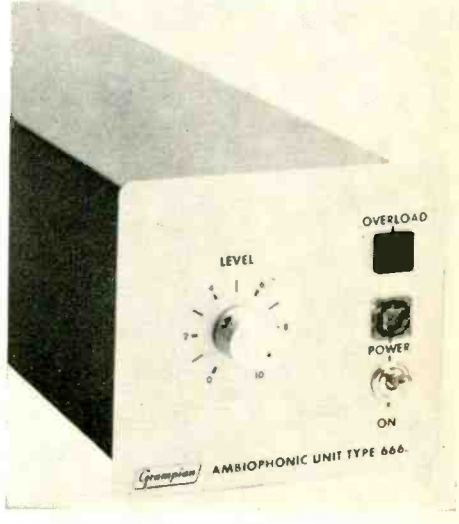
The *VA302E-C* delivers up to 300W of available vocal power and is rated at 100W rms continuous. The console has six input channels, each with its own individual volume, treble, bass and reverb in-out (and auxiliary echo) controls. Each input channel is fitted with a female Cannon type connector. The inputs are low impedance which allow microphone cable runs of almost any length. An additional feature is the provision of a VU meter that follows the audio material and gives positive reference to actual sound output: there is a two position VU meter sensitivity switch for high and low output levels. The *VA302E-C* may be used with any high quality low impedance dynamic, ribbon or condenser microphones.

The master controls of the *VA302E-C* may be used without disturbing the individual input settings. These include a master volume control that raises or lowers the volume of all channels simultaneously a master reverb intensity control, a master reverb in-out switch and master reverb treble and bass controls. Exclusive built-in protection against short circuits, open circuits and thermal overload guards the *VA302E-C* against electrical or heat damage. The entire front panel of the Console is illuminated for use on dimly lit stages.

The *VA302E-C* comes complete with three-conductor mains leads.
*Into an 8 ohm load.

Technical specification

Power output: 100W rms continuous voice power 300W peak available.
Gain: 80 dB (input attenuator out) into an 8 ohm load.
65 dB (input attenuator in) into an 8 ohm load.
Frequency response: flat ±3 dB from 50 Hz to 10 kHz.
Distortion: 5 per cent maximum at rated output.
Hum and noise: 60 dB below rated output.
Input impedance: suitable for microphones having an impedance of 50 to 600 ohms.
Power consumption: 400W maximum 240V ac 50 Hz.
Console weight: 186 kg.
Console dimensions: 212 x 208 x 123 mm.
Price: £336 before VAT.



Left: Grampian Reverberation Unit.
Right: Grampian *666*.

UNIVERSAL AUDIO

Manufacturers: United Recording Electronics Industries (USA).

Agents: F. W. O. Bauch Ltd, 49 Theobalds Street, Boreham Wood, Hertfordshire WD6 4RZ.
Tel. 01 953 0091.

Cooper *Time Cube*

COOPER TIME CUBE

Made for recording studio and motion picture sound applications, the Cooper Time Cube provides two electronically independent delays of 16 ms and 14 ms in one system.

The model *920-16* system uses techniques developed by Dr Duane H. Cooper of the University of Illinois and subsequent improvements by M. T. Pitnam of UREI.

The Cooper Time Cube system comprises: a rugged, grey-finished housing 630 x 630 x 240 mm, which contains the two coiled acoustical delay lines and their respective transducers; a 92 x 483 mm rack-mounting electronics chassis containing power supply, four *UA-1109* card-type amplifiers, equalising networks, meter and operating controls, and two standard microphone extension cables with *XLR-3* type connectors for interconnecting the chassis and the housing.

Technical specification

Electrical:
Frequency response: ±2 dB, 40 Hz to 10 kHz (typically ±1.5 dB).
Total harmonic distortion: less than 1 per cent (typically less than 0.5 per cent) at all program VU levels up to +4 dBm output. Distortion does not increase at low levels. (Because of hf pre-emphasis, distortion measurements should not be made at full output).
Signal-to-noise ratio: greater than 70 dB (15.7 kHz noise bandwidth).
Input sensitivity: −20 to +20 dBm for +4 dBm output.
Input impedance: 600 ohms transformer isolated (floating).
Output impedance: designed to work into 600 ohm load; transformer isolated (floating).
Inputs: two.
Outputs: two.
Channel separation: greater than 40 dB.
Time delay: channel A: 10 ms, channel B: 14 ms.
Wow and flutter: 0 per cent.
Mains voltage: 110-220V ac, or 220-240V ac (switch on rear panel).
Controls: input gain (2), output meter transfer switch, power off-on.
External connections: line cord, input jacks (2), tip-ring-sleeve (normalled to rear panel barrier strips) for permanent installations. Output jacks (2) tip-ring-sleeve (normalled to rear panel barrier strips) for permanent installations.
Physical:
Electronics chassis: width 483 mm, height 92 mm, depth behind panel 185 mm. (For mounting instandard 483 mm RETMA rack.)
Finish: panel, black anodized aluminium, white letters, chassis cadmium plated steel.
Delay lines housing: width 630 mm, height 630mm, depth 240 mm.
Finish: 12.5 mm plywood, grey zolatone with top handle.
Interconnectors: two twenty five standard two-conductor shielded microphone cables with XLR-3 type connector furnished for coupling between electronics chassis and delay line housing.

Weight:
Electronics chassis: 5.54 kg.
Delay lines housing: 16.35 kg.
Shipping weight: 28.2 kg (includes both units and cables).
Price: £555 plus VAT.

FIELD TRIALS

AKG BX20

By Angus McKenzie

MANUFACTURERS' SPECIFICATION. See page 52.

ONE OF THE recording engineer's most useful tools is artificial reverberation. In earlier days, the only really successful method of obtaining such reverberation was by the use of echo chambers having very carefully controlled reverberation characteristics. Such chambers were very expensive to make and frequently needed maintenance of one form or another. There was rarely any facility for altering the reverberation characteristics although ways subsequently developed of varying the absorption factor by adding or taking away structures suspended from the ceiling.

Several forms of magnetic recording device have been developed over the years, usually giving a series of discrete echoes which can be added together in different proportions. None of these devices, however, could give even an approximately exponential reverberation decay, so necessary to give the correct audible impression of true reverberation.

For over 15 years the EMT plate has been the most popular form of reverberation generator but it has suffered from many drawbacks, not the least being its unwieldy size and weight. The EMT plate is capable of adding reasonably acceptable reverberation to many sounds but produces a coloration on some audio sources, which can be a little unpleasant and is readily identified. It has a tendency to boom and is extremely sensitive to any external vibration, including external sounds. It is not possible to alter the reverberation time while the plate is in use and, unless a very expensive remote control unit is added, changes of reverberation time necessary for different types of music necessitate turning a wheel on the plate itself—which alters the position of a back acoustical damping plate.

The idea of using springs to obtain reverberation is certainly not new. I can well remember my own attempts some 16 years ago at using a spring, an old cutterhead at one end driving a pre-war crystal pickup at the other. I used a series of rubber bands along the length of the spring to control the damping! This crude device did produce reverberation but also gave audible twangs at the slightest hint of a transient. Several manufacturers have over the years produced spring reverberation units at very varied prices but these have unfortunately all suffered from the same twanginess to some degree.

In the *BX20*, AKG have been able to damp out most of the nasty resonances. They have also removed almost completely the twang normally associated with spring reverberation. They adopted a very neat way of altering the reverberation time by introducing carefully controlled feedback around the system. The result is claimed to be variable from 2 to 4.5s. The *BX20* under test was chosen at random from a normal production run. The unit was installed in a distant room and connected in a normal way to the main control desk. The two inputs to the *BX20* were normally connected to the two echo outputs of the desk and the outputs from the *BX20* fed back into the auxiliary inputs of the control desk, feeding main output groups One and Two. Equalisation was applied under the test conditions to both send and return sides and a tape delay was also added for some experiments.

The first tests included adding reverberation of varying times to speech in order to gain an initial impression of performance. Levels were carefully checked in and out and it was found that the output level on average was 4 dB lower than the input level although some resonances occurred giving a high output. Almost no twanginess was audible on speech and the performance was most acceptable. A very slight metallic quality was noticed when the reverberation time was at its longest but this was not really distressing. Pulses of both pink and white noise were applied using the recently released Rogers Developments generator. Such bursts of noise are a very critical test of a reverberation device and the results were quite astonishing. The spring twanginess was again almost unnoticeable and the decay was reasonably exponential. The frequency response seemed to be reasonably good and the quality of sound produced was remarkably similar to that normally associated with a good echo chamber. Crosstalk between the two channels was sufficiently low to meet all requirements.

Local noise

At this stage, attempts were made to interfere with the workings of the *BX20* by lightly tapping the wooden body and by speaking loudly in its vicinity. No interference was produced until the unit was lightly thumped rather than tapped. A teacup or plate being placed on top was also audible. Tilting the *BX20* created alarming noises, as would be expected. Although the unit is very delicate internally, it's mounting has been so cleverly designed that no harm resulted from its being transported twice round London before the field trial. The unit can be said to be transportable rather than portable and no difficulty should be experienced taking it out on a mobile recording session, provided that a large van is available.

Having successfully passed the first tests, it was decided that probably the most difficult test would be to add reverberation to a very dead recording made of a Steinway piano in the Queen Elizabeth Hall, at a live concert. The stereo microphone had been placed only 2m away from the piano for the original recording because of difficulties in placing mics at an ideal distance. When the *BX20* was used to obtain reverberation, it was possible to improve the sound quality of the piano dramatically. Different hall ambience characteristics could be simulated and, by controlling the stereo width of the direct sound in addition to the amount of reverberation injection, it was possible to simulate the sound that would have been produced by placing the microphone at various distances from the piano. The concensus of opinion among all who have heard this tape with *BX20* reverberation is that the sound produced is extremely close to natural hall ambience and certainly better than any other reverberation device heard before. Reverberation was also added to dead recordings of chamber music, orchestral music, organ music, and various types of pop material.

The facility of combining the stereo send to the unit turned out to be extremely useful, producing a fairly even reverberation from extreme left to right on input signals. In many cases this was found preferable to using the unit wholly in stereo, particularly when the original recording was made with comparatively few microphones.

Some interesting experiments were made adding reverberation to a recent recording of a Tijuana band made in a 'Salvation Army' hall having a very short but pronounced reverberation. Almost all the percussion had been recorded originally in the centre of the sound stage but most of the solo instruments were towards the edges. Adding echo stereophonically throughout tended to give two separate reverberation tunnels, left and right, on solo instruments whereas the percussion had too much reverberation coming from the centre. As a result, I decided to take the sum and difference signals of the stereo recording and send these in turn to the *BX20*.

As would be expected, the sum channel made matters worse but the difference channel very noticeably decreased the reverberation on the percussion and in fact was used almost throughout the dubbing session. Theoretically no central image sound from the original recording would be sent for reverberation but in practice the percussion spread considerably with random phase through pickup from other microphones used for the original balance. This technique of using a left minus right echo send has been frequently used by the BBC in drama productions to achieve special effects and is well worth investigation.

Tape delay

The application of tape delay can provide some very interesting sounds with the *BX20*. In general the tape delay should not be in excess of 100 ms or so and the ideal tape delay is given by a 76 cm/s tape speed, although 38 cm/s will be found satisfactory on machines having record and play heads fairly close together. Delayed tape echo produces the audible effect of the reverberation starting after

the equivalent of the first rebound of the sound from the back and side walls of a concert hall and can thus be very effective. Listening carefully to a comparison between direct and delayed reverberation also showed that the latter causes less interruption of signal clarity. The ear hears a transient direct, which places the sound source precisely, and yet notices reverberation a fraction of a second later. Slight muzziness was noticeable when the spring was used without delay because the transient was too closely followed by reverberation thus decreasing the accuracy with which the ear could detect precise placement.

Many interesting effects were produced by applying equalisation to the echo send, this being found preferable to equalisation on the return path. In many cases, bass cut was found necessary. Both mid lift and treble lift were useful in emphasising the reverberation of various instruments in their respective frequency response ranges, particularly when adding echo to a previously balanced stereo tape. In reductions from multichannel recordings, however, less equalisation was found necessary in the echo send circuit. It was important to note both the send and return levels and, to a degree, the reverberation quality could be changed by adjusting these. The acoustic noise level in the *BX20* is very low and was audible even when the device was being worked at a fairly high level. Although it is possible independently to alter the reverberation times of the two channels remotely, any difference of set time between the two channels caused the reverberation to swing towards whichever channel had the longer reverberation time. No audible effect was noticed when changing this time during operation, however, apart from the reverberation change, although my ppm showed the presence of very low frequency rumble during changes. This is regarded as a great improvement over the EMT plate which literally sounds like a psychedelic thunderstorm when subjected to the same treatment.

String tone

The effect of added reverberation on string tone is also an important test as poor systems can sound twangy or heavily coloured. The *BX20*, however, gave a pleasant singing reverberation to strings, thus allowing it to be used to enhance the sound of classical orchestral recordings. It was possible to change very noticeably the ambience characteristics on recordings from various concert halls, and a noticeable improvement could be made in the signal quality from both the Fairfield and Festival Halls. A comparison was made between the sound of an Albert Hall organ tape and that from an experimental tape made only from a somewhat closer single stereo pair plus *BX20* reverberation. Although only the master tape was immediately recognisable as having been made in the Albert Hall, the reverberation added to the close mic recording greatly enhanced its sound quality, producing an effect that could normally only be achieved in a cathedral. This effect did not sound at all artificial and was thus completely acceptable.

It will be obvious from the above that I am most enthusiastic about the performance of the *BX20*. Since the price is very competitive against the EMT plate, and the size is not a great problem, it would seem that AKG have produced a device that is going to be very popular throughout the world. It was difficult to find snags in the operation and perhaps the most serious is the inability to produce a reverberation time less than 2s. This will mainly affect its use in drama but should not cause any problems in music. I nevertheless had the impression that the higher reverberation times were lower than indicated by tha control unit. I also felt that the input impedance of approximately 4k ohms was too low and that this should have been the more usual standard of greater than 10k ohms. Furthermore the mono/stereo switch simply parallels the two inputs and this could cause serious problems since it would parallel directly two line output stages causing each to load the other. This could be obviated by inserting 270 ohm resistors in series with live and neutral on the input *XLR* sockets. For most music, an indicated 3s reverberation time seemed to produce the same type of reverberation as that from a concert hall having a measured time of 2.5 to 2.8s.

Perhaps the best final summing up is the answer to the question: Would I myself like to own and use a *BX20?* My answer would definitely be in the affirmative.

AKG BX20

By Hugh Ford

MANUFACTURERS' SPECIFICATION

Input level: +6 dBm (1.55V)
Maximum permissible level: +12 dBm (3.1V)
Output level average: +6 dBm (1.55V)
Input impedance: 2k ohms symmetrical per system; 1k ohms parallel switched.
Output impedance: 50 ohms symmetrical.
Reverberation decay time: continuously variable from 2 to 4.5s per channel, separately.
Level difference between channels: 3 dB maximum (depending upon reverberation time).
Signal-to-noise ratio (+6 dBm): 69 dB.
Frequency response: 20 Hz to 8 kHz at a bandwidth of ±5 dB from standard curve. Measured with pink noise at input, the output signal being recorded in thirds.
Insertion loss measured with third-octave noise at 1 kHz: 0 dB at input; 3 dB maximum at output.
Channel separation: 60 dB (DIN 45405).
Acoustic feedback protection: 100 dB spl.
Elastic suspension: natural resonance of the suspension less than 1 Hz; usual shock does not produce disturbing effects but periodic low frequency vibrations should be avoided.
Power supply: 220/110V 40 to 60 Hz, or 22 to 30V dc, 500 mA fuse.
Power consumption: 12W.
External dimensions: 430 x 500 x 1,100 mm.
Weight: 50 kg.
Maximum permissible inclination: 1.5 per cent.
Price: £1,075 plus VAT.
Manufacturers: AKG Akustische U. Kinogerate GmbH, 1150 Wien, Nobilegasse 50, Austria.
Agents: AKG Equipment Ltd, 182/4 Camden Hill Road, Kensington, London W8.

WHILE AKG are well known for the manufacture of very high quality microphones and headsets, the production of a reverberation unit was a relatively new departure albeit a logical step when it is realised that reverberation units essentially involve electroacoustic transducers.

As is true of microphone and loudspeaker measurements, electroacoustic measurements of reverberation units may be extremely deceptive but are an interesting technical exercise which will undoubtedly define some of the performance parameters. At the current state of the art it is impossible to judge the overall performance of loudspeakers, microphones or reverberation units from electroacoustic measurements alone. In the end we come down to what the trained ear hears, and this aspect of the AKG reverberation unit is the subject of a field trial (page 50).

Probably the most widely used studio reverberation unit is the EMT *140* plate. Many of these lived solitary lives in studio cellars but, in recent years, have been joined by a companion for stereo recording. While the plate has apparently been superseded by the *240* foil, the space per channel occupied by the latter is slightly more than that of the AKG unit.

The sample *BX20* arrived direct from London Airport, packed in an enormous cardboard box inside which was a further cardboard container supported by polystyrene corners. In view of the weight of the unit, I have my doubts if this packing would survive the standard surface transport test from London to Glasgow return! However, the construction of the unit is substantial, the housing being a smart wooden cabinet which would be quite at home in many sitting rooms.

Access to the interior is gained by removing three Allen screws which secure the back of the cabinet, the other side of which is hinged. At the bottom of the hinged door are the various electrical connections comprising two three-pin *XLR* plugs for the floating inputs, two three-pin *XLR* sockets for the floating outputs, a five-pin *XLR* plug for external 24V powering, and a five-pin *XLR* socket for connecting the remote control unit. All these connectors are of the locking type. In addition to the above are a 'Continental' mains connector, fuse on/off pushbutton, pilot lamp and a rotary switch with which the two channels may have their inputs connected together.

All the electronics are located inside the hinged door and are arranged on two plug-in printed boards incorporating transistors and integrated circuits. Both the power supplies and the cables to the torsion elements also plug in so it would be a very simple matter to replace faulty units.

The torsion elements, which employ electronic damping by means of motional feedback, are located on a complicated system of springs and wires in turn supported by a massive metal framework. The support system gives the impression of being well engineered and capable of withstanding considerable mishandling in transit.

The unit may be powered from either nominal 110V or 220V mains when it was found to consume 7.7 VA, or from a nominal +24V supply when it drew 160 mA. In the absence of a mains input, the dc powering automatically takes over. It was found, however, that the instruction leaflet quoted the incorrect connector pin numbers for the dc power supply. In the cases of either ac or dc powering, the input voltages could be varied over fantastically wide margins before there was any audible degradation in performance.

Because the gain of the two channels is fixed (other than the mains on/off switch which is mounted on the unit) there are only two controls, one governing the reverberation time of each channel. These two potentiometers are mounted on a remote control unit which is supplied with 10m of cable terminating in a five-pin *XLR* socket. The remote control unit, which also includes a pilot lamp, is designed so that it may be mounted in a studio console which can be located at practically any distance from the reverberation unit as the control signals are dc and therefore unlikely to be upset by any practical extensions of the control cable. In fact, AKG suggest that extensions of up to 5 km may be used!

The input impedance at the floating input was measured as 4.79k ohms at 1.592 kHz with the inputs separate, or half this impedance with the inputs paralleled by the inbuilt switch. From the point of view of bridging 600 ohm lines, the input impedance is low by a factor of two. It is, however, pleasing to have a completely floating input and the impedance is to specification.

Like the inputs, the outputs are completely floating and offered an output impedance of 32 ohms which is conveniently low for working into any standard line impedances. The manufacturers' rated input level is +6 dBm with a permitted maximum of +12 dBm, the former giving a maximum output of +4 dBm on channel One and some 1.5 dB less on channel Two, all of which did not vary with reverberation time settings.

The rms signal-to-noise ratio at the output, related to an input level of +6 dBm, was measured as follows:

	Channel One	Two
Reverberation time 2s		
Unweighted noise (20 Hz to 20 kHz):	60.5 dB	60.0 dB
Weighted noise:	70.0 dB(A)	69.0 dB(A)
Reverberation time 4.5s:		
Weighted noise	67.3 dB(A)	66.5 dB(A)

This noise performance would suggest that if noise is critical, there is a good case for driving the input up to its maximum permitted level of +12 dBm which will provide an extra 6 dB on the above figures and provide a very good signal-to-noise ratio.

Any attempts to measure harmonic distortion under reverberant conditions are essentially doubtful measurements but, for what it is worth, a 1 kHz frequency modulated signal was applied at +12 dBm to the input and the output of the unit examined with a third octave filter at 1 kHz and 3.15 kHz centre frequencies. The resulting third harmonic content was found to be less than 0.06%!

Another rather doubtful exercise was an attempt to discover the frequency spectrum of any colorations introduced by the unit. A single rectangular pulse of 1 ms duration was applied to the input at five-second intervals and a third-octave analysis performed on the output of the reverberation unit. The resulting analysis showed that outputs in the 100 Hz to 630 Hz range were predominant.

Reverting to more conventional measurement techniques, the frequency of both

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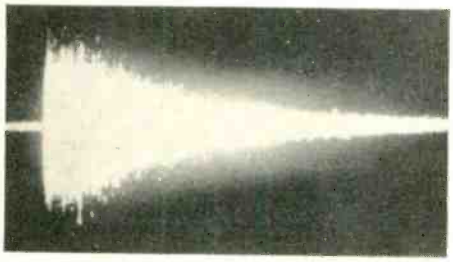
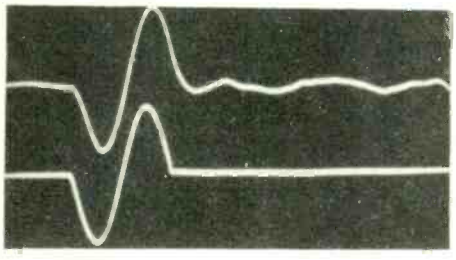
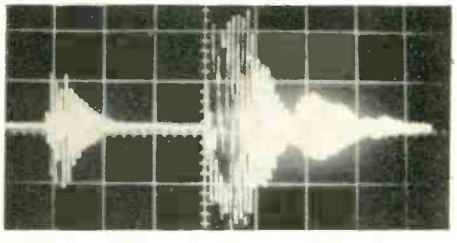
channels at maximum and minimum reverberation time settings was investigated by means of third-octave bands of pink noise. As can be seen from **fig. 2,** the response is substantially flat from 80 Hz to 3 kHz and falls off fairly rapidly outside these limits. If the reverberation time setting is reduced from 4.5 to 2s, this fall in output is somewhat steeper but the flat section is maintained. With the exception of a 3 dB dip in response around 250 Hz on channel 2, the response of the two channels was virtually





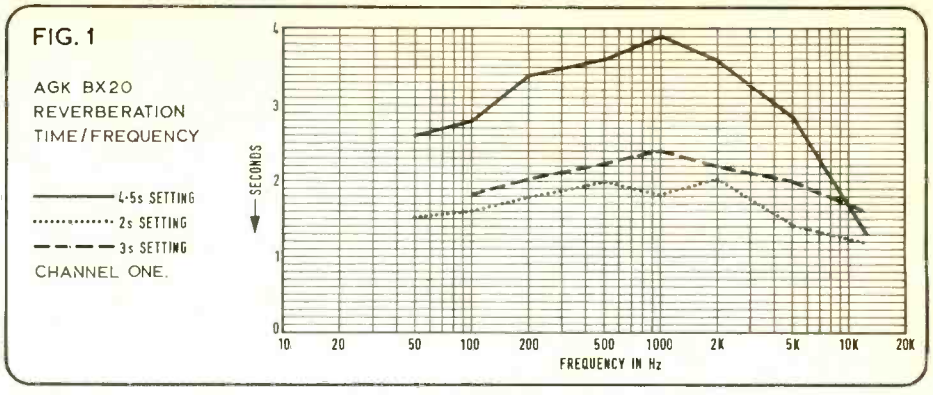


identical at all reverberation time settings. While the loss of high frequency response may at first appear to be rather alarming, this is a normal consequence of reverberant conditions.

Investigation into crosstalk between the two channels by means of third-octave bands of pink noise showed that the worst crosstalk occurred around 250 Hz where it was a good −64 dB. Crosstalk decreased to a fantastic −80 dB outside the 80 to 800 Hz frequency band where it remained below system noise.

Initial investigation into the reverberation time (conventionally the time for a signal to fall 60 dB after its rapid removal) was undertaken with third-octave bands of white noise, the output of the reverberation unit being examined with a Bruel & Kjaer level recorder which is conveniently supplied with a protractor for the direct reading of reverberation time.

Fig. 1 shows the measured reverberation time as a function of frequency and reverberation time control setting. While this figure was obtained from channel One of the unit, channel



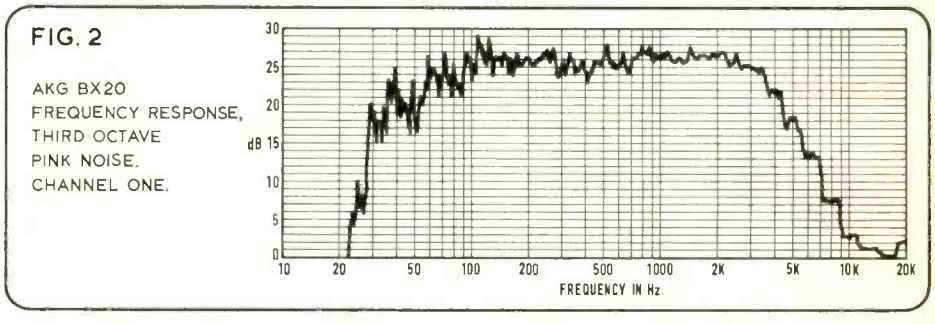


FIG. 3 High left.
FIG. 4 Centre left.
FIG. 5 Low left.

Two displayed virtually identical results. Two matters are apparent from this figure. Firstly, the specified maximum reverberation time of 4.5s could not be reached at any frequency. Secondly, the calibration of the reverberation time controls is somewhat arbitrary. It was also noted that AKG publish a curve which shows an increase of reverberation time at low frequencies, in contrast to a measured decrease in reverberation time which may in fact be preferred.

Fig. 3 shows the decay characteristic of wide band white noise and demonstrates that the decay follows the desired exponential form, while **fig. 4** shows the degradation (if any) of a single cycle of 1 kHz sinewave passing through the unit and shows that there is a complete absence of any undesirable ringing, which was also confirmed by examining the output of the unit when very fast risetime pulses were applied to the input.

It may well be tempting to vary the reverberation time settings when the reverberation unit is on line. This procedure could be somewhat disastrous, however, because movement of the time controls could produce the output shown in **fig. 5** which may be clearly audible for 3s after the controls have been adjusted.

A final point of interest is the AKG claim: 'Full insulation against vibration and structure-born sound'. While this claim is somewhat far fetched, the *BX20* certainly does not need to be hidden in the bowels of a studio but can be accommodated in the control room if reasonable precautions are taken.

Subjecting the top of the cabinet to a vibration of 0.1 m/s at 100 Hz produced an output signal between 21 and 23 dB below an effective input of +6 dBm which is similar to the result of putting down a coffee mug on top of the unit. It follows that the unit should be protected from tools and teacups when in use and that considerable care should be exercised if the unit is to be used in mobile applications.

Summary

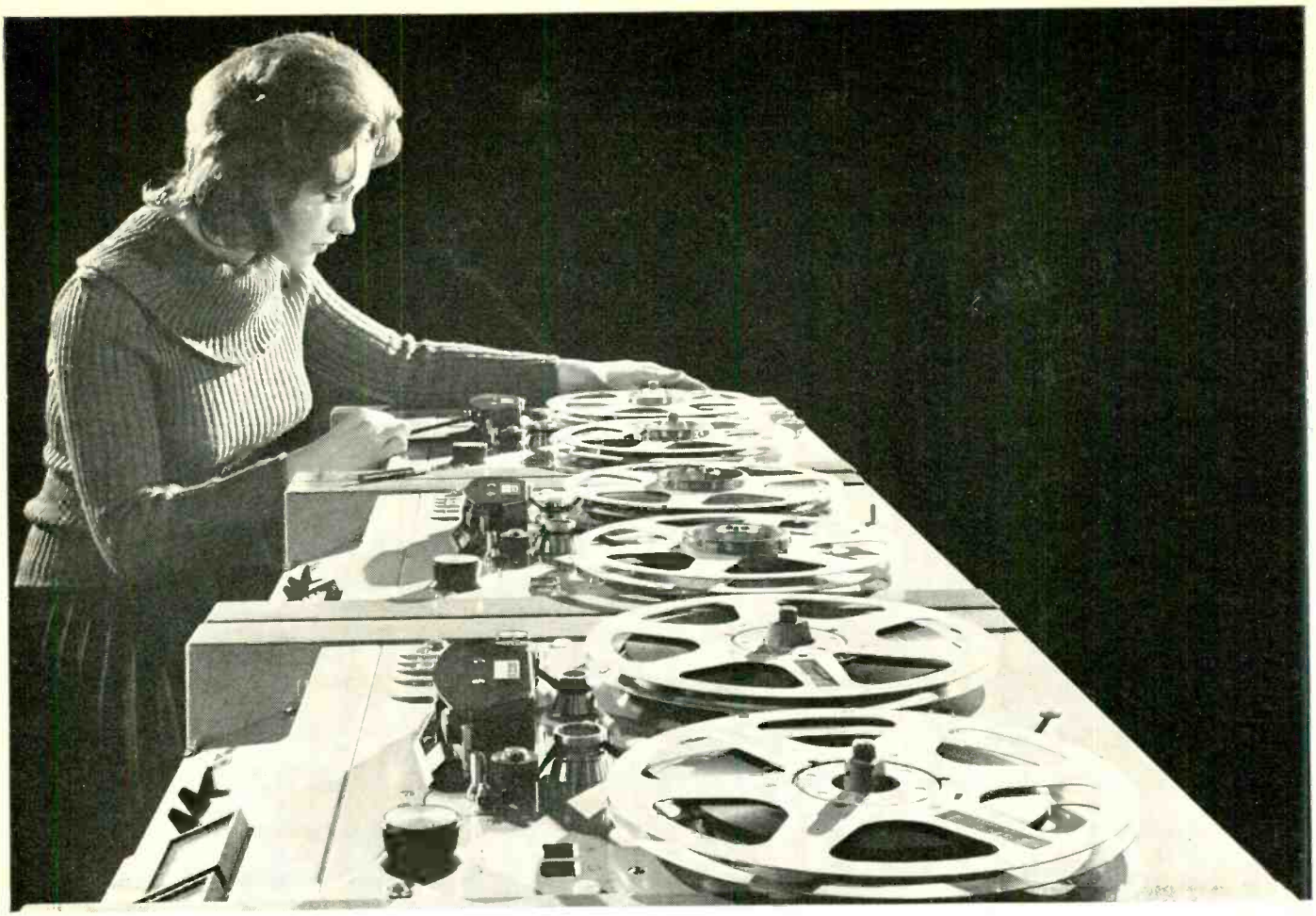
The mechanical construction standard of the *BX20* reverberation unit is excellent and its design is such that there is no need to insert clamps in the mechanical suspension or take any other precautions in transport. Although it is essential to protect the unit from shocks or undue vibration in use, it is completely unnecessary to house the unit in a quiet environment. In this context, the remote control facility provides more than is required but it is perhaps an inconvenience that it does not include a power on/off switch.

Input and output levels are generally convenient but the input impedance is somewhat lower than may be desired for 600 ohm line working. The signal-to-noise ratio is adequate at normal line levels but some advantage can be had by feeding the unit with its maximum permissible level of +12 dBm.

While the maximum specified reverberation time of 4.5s could not be obtained, and the calibration of the reverberation time controls is rather inaccurate, this is unlikely to be of significance in practice when it is normally not necessary to know the actual reverberation time. The measured reverberation time of just under 4s is more than is normally required.

Overall, the performance of the AKG reverberation unit was impressive from a measurements point of view but brief listening tests suggested a rather 'empty tunnel' characteristic.

Hugh Ford



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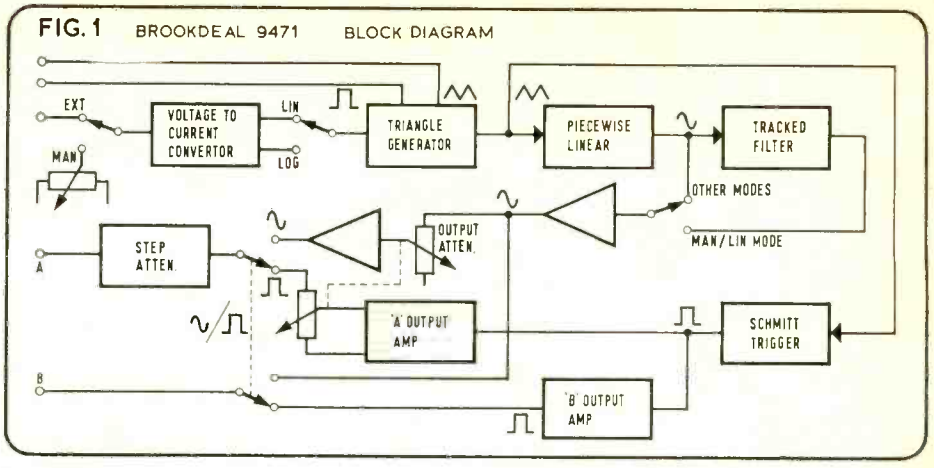
BROOKDEAL 9471 GENERATOR

By Hugh Ford

MANUFACTURERS' SPECIFICATION

Frequency range: 0.001 Hz to 1.1 MHz.
Total harmonic distortion: typically 0.05% up to 10 kHz.
Frequency control range: 10^2:1 linear, 10^4:1 log.
Calibrated output (A): 3.16V rms to 1 μV rms sinewave, 3.16V rms to 1 mV square wave, microvolt levels from 1 ohm low noise source.
Output (B): waveform as output A but fixed 3V p-p.
Quadrature outputs: two orthogonal outputs (triangle and squarewave) provide 3V p-p.
Frequency stability: 0.04% over 24 hours.
Amplitude stability: 0.02% over 6 hours.
Squarewave performance: rise time typically 30 ns; overshoot typically 2%.
Attenuator accuracy: ±1% with output greater than 10 mV; with output less than 10 mV: ±1% up to 10 kHz decreasing to ±3% at 1 MHz.
Manual output: dc voltage proportional to the frequency setting of the manual control.
Power requirements: 105V to 130V and 210V to 260V ac 50 to 60 Hz 15W consumption.
Dimensions: 218 x 87 x 285 mm.
Weight: 2.9 kg.
Price: £265+VAT.
Manufacturer: Brookdeal Electronics Ltd, Market Street, Bracknell, Berkshire.

FIG. 1 BROOKDEAL 9471 BLOCK DIAGRAM



BEFORE DEALING with the review of the Brookdeal *9471*, it must be mentioned that the full manufacturers' specification occupies some three sheets of print so it was decided to extract the aspects of particular interest to the audio engineer to accompany this review. The bulk of the remaining specification places emphasis on stability and also provides more detail of the special outputs intended for use with other equipment in the Brookdeal range.

The circuit techniques of the *9471* signal source are strange to an audio engineer because, instead of using a sinewave generator as the basic signal generator, the unit uses a triangle generator the frequency of which is voltage controlled. The resulting triangular waveform is then fed to a 'piecewise linear' network which literally assembles a sinewave from the triangular wave by means of a series of gates. It follows that the resulting sinewave will contain a fairly high harmonic content so it is then passed through a variable filter which tracks its frequency with the main frequency control. Because the tracking filter is low pass, the predominant harmonic in the output waveform is the second harmonic. Higher harmonics are at an extremely low level.

When a squarewave output is required, this is generated by feeding a Schmitt trigger from the triangle generator. Alternative sinewave or squarewave outputs are available from two BNC sockets on the front panel (which are duplicated on the rear panel) at either a fixed level (output B) or via buffers and a switched 10 dB step attenuator which provides attenuation of up to 130 dB for sinewaves or 70 dB for squarewaves.

The front panel layout is delightfully straightforward with all frequency controls on the left, and outputs and output controls on the right. It has been mentioned that the frequency is derived from a voltage controlled oscillator, but the details of the voltage feed to the oscillator deserve some description by two interlocking pushbuttons on the front panel, such that the tuned frequency is proportional either to the input voltage (LIN) or to the logarithm of the input voltage (LOG), the latter being of particular interest in the field of audio.

A further three interlocking pushbuttons select the source of the frequency control voltage so that it can be derived from an integral frequency control, from an external source, or from a combination of both. This flexibility is ideal for using the instrument in combination with an oscilloscope of chart recorder for producing frequency response data displays. The integral frequency control is operated by a slow motion drive, which has a good compromise ratio for fine frequency setting, and is associated with a clearly calibrated dial which has a basic range of 10:1 but also includes a more than adequate overlap. The dial also includes a rather makeshift secondary scale for use with the instrument in the LOG mode of control, where the frequency dial covers some four decades.

Associated with the frequency dial are six range selection pushbuttons which are engraved with multiplying factors for the frequency dial, such that the instrument covers 0.1 Hz to 1.1 MHz in the linear mode of operation and using the range overlap portion of the scale where frequency calibration is poor at the lower end. In the logarithmic mode the instrument covers 0.001 Hz to 1 MHz, but frequency calibration is poor in this mode even when the alternative dial is supplied with the logarithmic calibration as the main scale.

The right-hand side of the front panel includes pushbutton selection of either sinewave or squarewave output, which is fed to both the fixed outputs 'B' and the attenuator output 'A'. The attenuator itself comprises a 10 dB step which is clearly calibrated from 3.16V rms down to 1 mV rms in the case of sinewave outputs, plus an associated concentric variable attenuator. The variable output 'A' is also equipped with an output on/off pushbutton switch, which can be very useful. The final front panel control is a pair of pushbutton switches which give the facility of either earthing the output sockets, or allowing them to float with a 30V capacitor to earth—the working voltage of this capacitor does appear to be decidedly on the low side.

The rear panel includes duplicate output sockets, the mains input socket and its associated fuse and voltage selector, and the auxiliary inputs and outputs which are as follows: Firstly there is a DIN socket which provides orthogonal outputs from the triangle generator in the form of a triangular waveform and a 90° squarewave. There are then three BNC sockets associated with the voltage control function of the oscillator: one socket gives a dc output between 10 mV and 1V depending upon the main frequency dial setting, and the remaining two sockets are control voltage inputs of different sensitivities (10 mV to 1V or 100 mV to 10V).

The overall handling of the instrument was very good and in use one never had to stop and think to find a control or to worry about such matters as scale multiplying factors. The one thing missing from the instrument is an output voltage meter and, while this is quite unnecessary for many applications, it could well be a deterrent to purchasing the instrument.

So much for the description of the signal source; how does it perform from the point of view of an audio engineer? Normally the ancillary outputs, very low frequency performance, and other similar factors would be of little interest, so these were not investigated in any detail. The following deals with the parameters of most interest.

Frequency

The accuracy of frequency calibration was checked at three points on each range in the linear mode of operation, at each end of the scale (excluding the overlap) and at mid scale. Below 50 kHz the accuracy was within the specified ±1% ±0.05 Hz but the error within the highest frequency range increased to as much as −2.1%. Oscillator loading had no measurable effect upon frequency, nor did varying the mains voltage over wide limits.

It was noticed that the frequency drifted to a small degree after tuning the oscillator (see **fig. 2**) on some occasions but, once the oscillator had stabilised, the drift became minimal. One advantage of the 'piecewise linear' method of generating sinewaves is the ability to produce extremely low frequencies with little distortion. As these very low frequencies are of little interest to the audio engineer, no attempt was made to assess the performance below 1 Hz.

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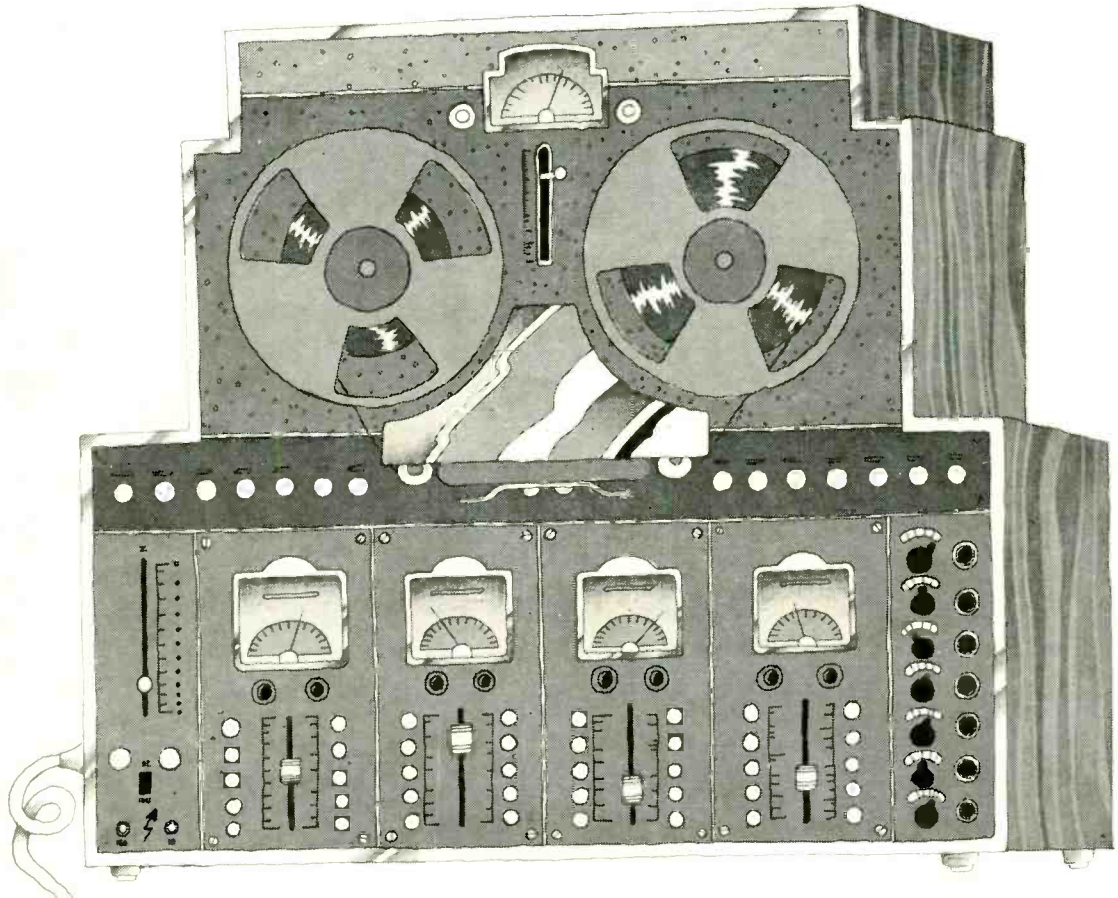
A 3-head, 30-20,000 Hz, 24 Watt, 4-track stereo, semi-professional, £95 let-down.



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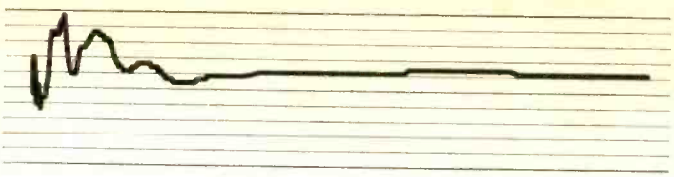


FIG. 2
Frequency drift of 20 hHz on setting frequency. 2 Hz per vertical calibration. Paper speed: 0.3 mm/s.

It is also very time consuming to evaluate frequencies such as 0.001 Hz, where one cycle occupies almost 17 minutes!

The relation between the frequency control setting and the dc output at the back panel socket was found to be as follows:

Control setting	Output voltage
0.1	0.009V
1.0	0.102V
5.0	0.517V
10.0	1.04V
11.0	1.15V

This means that the dc output voltage is very close to the nominal specification, and is in fact a fairly good indication of tuned frequency.

Distortion

Total harmonic distortion of the attenuator output without any load was measured between 5 Hz and 500 kHz at maximum output voltage (which is normally the worst case condition) with the following results:

Frequency Hz	5	10	100	1k	10k	100k	500k
Distortion %	0.2	0.3	0.05	0.05	0.19	0.32	0.66

The performance between 100 Hz and 1 kHz is certainly excellent but at higher frequencies it is disappointing compared with the specification of 0.05% up to 10 kHz. However, the distortion is mainly second harmonic, the figures at 1 kHz being 0.04 per cent second, 0.009 per cent third, 0.002 per cent fourth.

Mains hum in the output was extremely low, the worst mains frequency component being the third harmonic at 150 Hz which was measured as some 73 dB below the output, with the fundamental 50 Hz being at –80 dB. Likewise noise in the output was greater than 80 dB below the signal in both the sinewave and squarewave modes of operation.

Amplitude bounce was virtually non-existent when changing the frequency setting, and even changing the frequency range produced extremely little amplitude bounce.

Squarewaves were also to a very high standard with the rise time independent of the frequency and measured at 30 ns for 10 per cent to 90 per cent change in amplitude. No ringing was observed and overshoot was minimal.

The attenuator (A) output gave a maximum of 3.09V rms into an open circuit, compared with the nominal 3.16V (0.2 dB error only) from a source impedance of 600 ohms with attenuator settings of 1 mV and above. When the generator was switched to squarewaves, the rms output increased by 0.4 dB which is normally of little consequence.

Attenuator accuracy was within 0.04 dB at 1 kHz and the variable control gave a range of just over 12 dB which provides a good overlap with the switched control. When the switched attenuator is set to outputs below 1 mV, the output impedance falls to about 1 ohm and squarewaves are automatically no longer available.

Operation of the signal on/off switch provided an audio frequency breakthrough of less than –120 dB, falling to 30 dB at 1 MHz, while also illuminating a small lamp.

Output B, the fixed output, which is a nominal 3V p-p, gave a measured 3V p-p on sinewaves or 3.12V p-p on squarewaves, which is a useful level for triggering oscilloscopes, acting as a phase reference, and so on.

The flatness of the attenuator output was within ±0.3 dB right up to the top frequency of 1 MHz and within less than 0.1 dB over the audio frequency range.

The Brookdeal *9471* is a rather specialised source of sinewaves and squarewaves which includes facilities not normally required for audio measurements; it also includes features which could be invaluable for routine testing work. Into this category comes the wide range frequency modulation facility together with the option of either linear or logarithmic sweeping: these features are a sound basis for automatic response tracing or for external programming to set frequencies. Also, as a result of the high upper frequency limit, the signal source can be used for the alignment of medium frequency radio equipment. It is here that the wide output attenuator ranges are also of interest as, for most audio frequency applications, outputs in the order of microvolts are not normally of interest.

For the majority of audio frequency purposes the little brother of the *9471*, known as the *9472* and costing £98 less, will do all that is required.

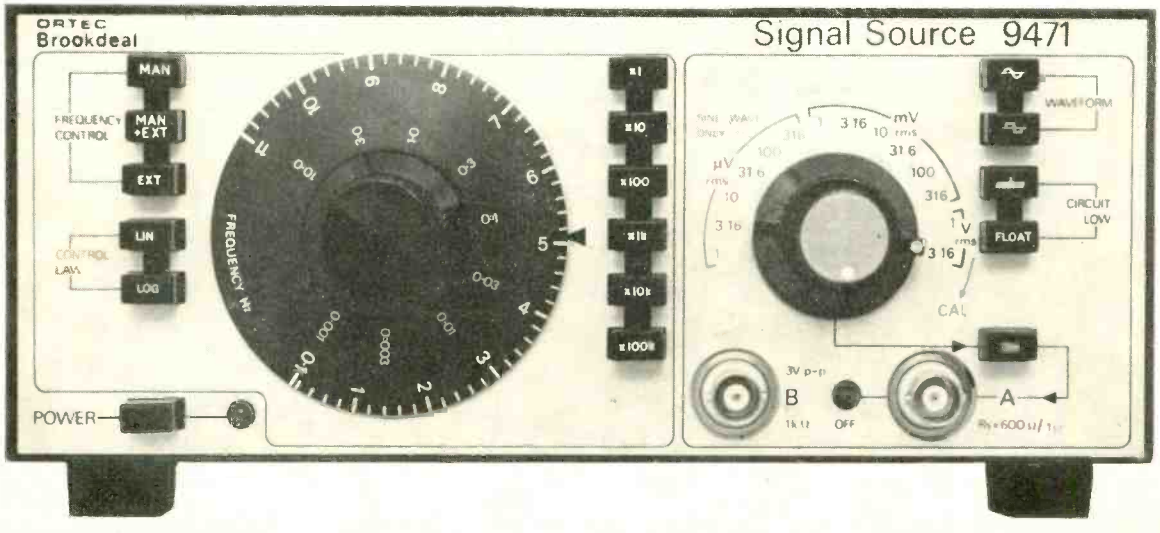
Summary

While the manufacturers' specification for the *9471* would appear to be an 'average instrument' type, as opposed to a worst case specification, the performance of the instrument is certainly good. This is one of the very few signal sources that can offer really low audio frequency distortion which alone, in combination with the facility for frequency modulation, makes the instrument attractive.

Other attractions are the very wide range of output levels, excellent flatness of output, good squarewave performance, and a tidy and intelligent layout of both the front and rear panel.

On the debit side, some aspects of the published specification were not met but these are probably of little consequence with the exception of the distortion performance at the upper end of the audio frequency spectrum. Probably of more significance is the lack of any output meter, but the output levels at maximum variable attenuator settings are close to their nominal values.

Overall, this is no cheap instrument, but it has facilities which are uncommon and can be of great value for certain applications.



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D.60 the 100 watt amplifier

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RAC AUDIO MODULES

By John Fisher

MANUFACTURERS: RAC Modules, 19 Freemantle Road, Bilton, Rugby.

READERS OF the 'square ads' at the back of STUDIO SOUND will doubtless have noticed Rugby Automation Consultants' advertisement for relatively low price custom-built mixers and modules. The modules are intended for amateur and industrial users, for building mixers or extending existing equipment.

All the modules are constructed on 1.6 mm fibreglass or srbp board, using silicon transistors. The modules are mostly of a standard 63.5 mm size with one edge used as a connector. Solder pads for connections are an alternative. The standard srpb boards have tinned edge connectors, the fibreglass boards (55p extra) have gold plated connectors. Edge connector sockets and matching components are available.

General observations

The modules sent for review were the *MAI.1* microphone amplifier, *MAI.3* buffer amplifier, *MAI.4* emitter follower buffer, *TI.1* tone control unit, *PAI* monitor amplifier and *PI.1* power supply unit. All the transistors used were Lockfit types and this immediately rang a bell: apart from the monitor and power supply modules, all the circuits follow very closely the designs in the Mullard leaflet *Audio Circuits Using Lockfit Transistors*. The monitor amplifier is built very closely to a General Electric ic design. The finish of the fibre-glass boards was very much better than that of the srpb boards. The edges of the latter were chipped and gave a rather 'home made' appearance to the boards. The manufacturers warn against repeated plugging and unplugging, to avoid damage to the edge connector.

I would strongly recommend paying extra for the gold-flashed contacts and connectors if reliability is at any sort of premium. Anyone who uses these modules rather than building their own will not wish to fiddle too much and experience shows that, to be reliable, this sort of edge connector is really best gold plated. Alternatively, if you're saving the 55p per module, save a bit more by abandoning the edge connector and use a miniature flexible connector strip as employed for mains and other lash-up connections. This can be mounted on the board and connections made along one edge to the line of drilled solder pads provided. Connections to the rest of the equipment can then be made with screw terminals.

Adequate connecting details are provided in the RAC literature and the supply, input, output and some other terminals are sensibly marked on the copper side of the pc board for easy identification. All the units operate off a 24V negative earth dc supply but can be powered by three 9V batteries. The boards may be chassis mounted at the corners with holes on a 59 mm pitch if permanent connections are made through the holes provided. If connectors are ordered with the modules, a polarising slot is provided.

PI.1 power supply (£3.75)

The power supply module was naturally the first tested as it provided a convenient means of testing the other modules. It is rated as 24V 35 mA voltage stabilised. It does not conform to the size of the majority of the modules, being the same width but longer. Rather dangerously, it uses the same edge connector as the *MA* and *E* ranges, but keying slots and keys are available to prevent amplifiers being plugged into the mains.

A sub-miniature non-toroidal transformer is used, 20-0-20V 30 mA secondary, 240V primary with screen. This feeds a bridge rectifier, capacitor, series resistor and second capacitor, with a 24V zener diode across the output.

With 23.5V mains input, the units provided a supply of 25.5V on open circuit, dropping to 24V with a 1k load, representing a drain of 24 mA. On open circuit the zener gets very hot indeed; the transformer remains slightly warm all the time. The unit tolerated a 35 mA load for 24 hours without distress.

Hum level was adequately low for use with all the units and was mainly 100 Hz with small spikes observed on an oscilloscope.

The unit will drive several modules simultaneously but owing to the small current rating, will not provide adequate power for the monitor amplifier when used with a 15 ohm load. If the monitor amplifier were used for driving a meter, for example, when the power requirements would be much lower, this should present little problem (the monitor is rated at 20 mA quiescent by RAC).

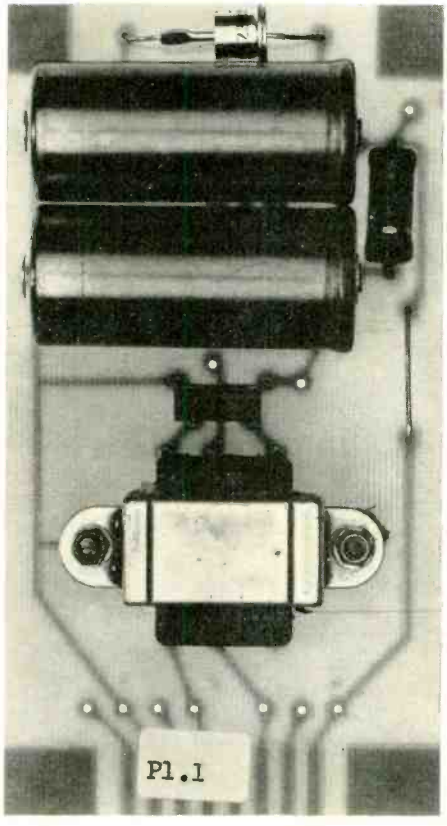
I would suggest that the edge connector be not used for carrying mains and that a flexible connector strip be used instead as outlined above. I would also suggest that it is worth getting the fused version of the power supply and providing a small external fuse for the mains.

MAI.1 microphone amplifier (2.25 basic)

The *MAI.1* is a two-transistor microphone amplifier with a maximum gain (preset) of about 40 dB. With the exception of the preset gain and decoupling components, the circuit follows very closely the original Mullard design, even to using *BC148* transistors rather than the marginally quieter *149* or *169* that one might expect in a mic amp. However, a signal-to-noise ratio of 68 dB (unweighted was measured at 1V rms output with the gain set to 15 dB. Mullard quote a noise voltage of less than 1 μV referred to the input. Under the same conditions as the above, they measured 0.075% at 1V rms output. The output clipped at above 4V rms into open-circuit and about 1.2V rms into a 1k ohm load. The response was ruler-straight from 20 Hz to 20 kHz as fig. 1 shows.

I did not like the miniature skeleton preset on the review sample. My own experience of these has been that they become troublesome —intermittent or noisy. I would prefer an enclosed and slightly more robust type. Alternatively the preset may be removed and the spare connector pin used to provide preset gain on the equipment front panel, using a large pot or switched resistor.

62 ▶



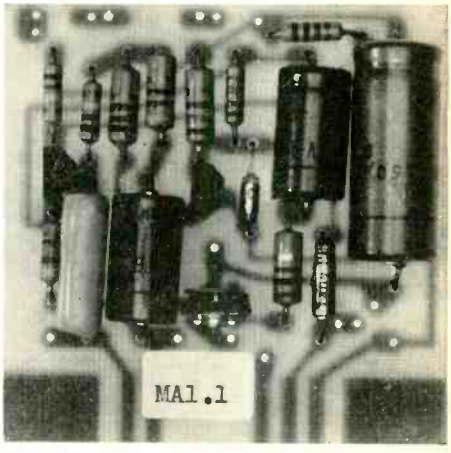
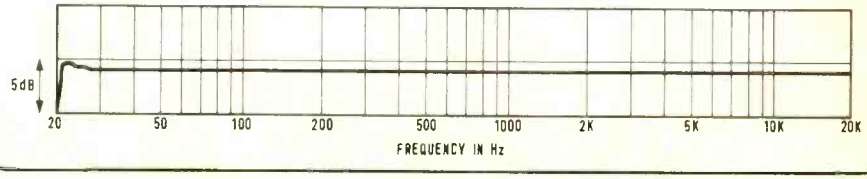


FIG. 1 RAC MAI.1 MICROPHONE AMPLIFIER FREQUENCY RESPONSE



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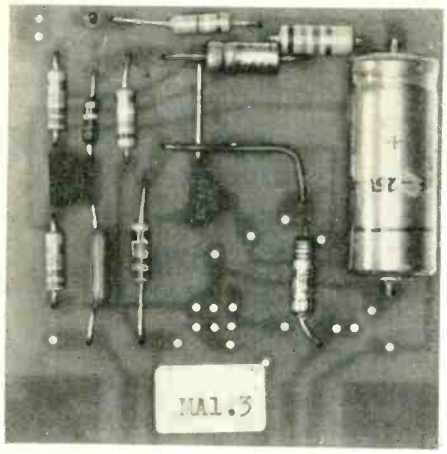
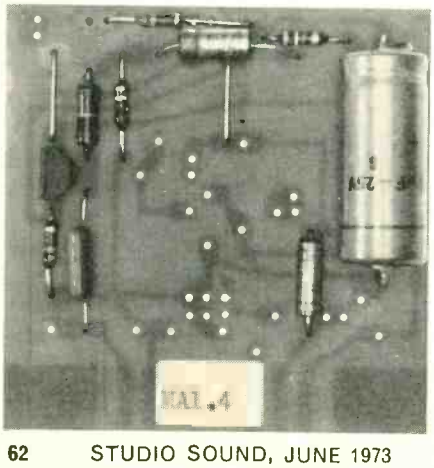


MAI.3 amplifier (£2 basic)

The *MAI.3* is a dual-stage unity gain amplifier with an input impedance of over 3M ohms. Again, a straight copy of the Mullard circuit, using *BC148* transistors and described as suitable for crystal microphone input. The literature suggests that the *MAI.3* can be used as a buffer in front of an *MAI.1* to increase the input impedance. The first transistor operates in common emitter mode, with equal emitter and collector resistors, bootstrapping of the base bias of the first transistor and an emitter follower after the collector output. The response is as wide as the *MAI.1* and distortion is low (under 0.1 per cent at 1V rms). Typical noise level should be 9 μV with a 1M input source. Output impedance is about 250 ohms. Distortion increases rapidly above about 2.5V rms. The *MAI.3* uses the same pcb as the *MAI.1* needing less of the terminations and a couple of wire links. Except for slight capacitor value changes, the circuit is as Mullard's. Considering the supply voltage is 24V, the signal handling is rather poor.

MAI.4 emitter-follower (£1.75 basic)

The *MAI.4* is simply an emitter follower with bootstrapped bias to keep the input impedance up. Input impedance is about 1M ohms nominal, and output impedance 250 ohms.



EI.1 preamplifier (2.25)

The *EI.1* is a three stage preamplifier on a similar sized board to the *MAI* range, using the same edge connector so that boards can if necessary be interchanged easily. The circuit is basically Mullard for equalised inputs, with the addition of an emitter follower before output and feedback. It is claimed that this, with the use of a *BC149* in the first stage, ensures low noise, distortion and output impedance, and a high overload capacity. In fact the overload was rather poor, though in other respects the module functioned well. Output terminals are provided for remote equalising components or they may be mounted on the board in the holes and spaces provided. Gain may be reduced 30 to 40 dB without instability.

The performance with an RC network to give an approximately 70 μs characteristic is shown in fig. 2. Clearly the gain is ample for such applications. Other versions of the board are available with preset frequency characteristics or gains including one for medium impedance microphone; specials are available at slight extra cost.

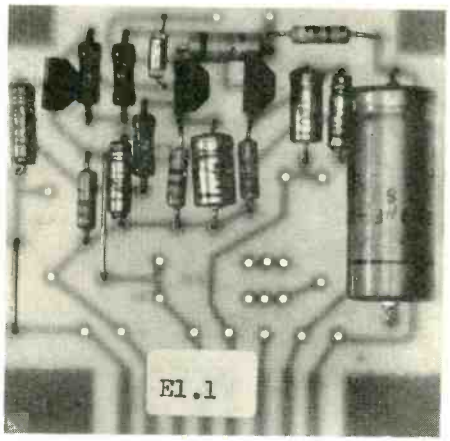
I suspect that a slight error may have crept into the pcb layout in adding the emitter follower as the decoupling does not follow the same principle as the other amplifiers. The decoupling capacitor appears straight across the supply instead of after the decoupling resistor; on the other hand this arrangement does minimise the risk of damage to the emitter follower transistor if the output is shorted.

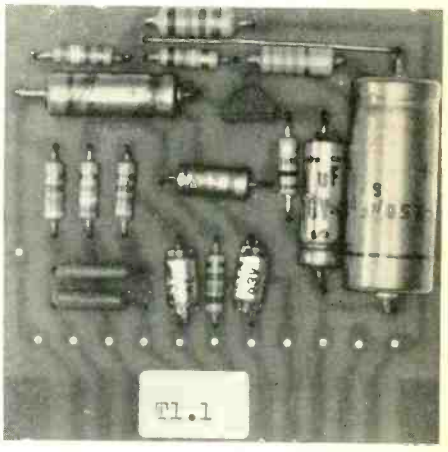
RAC quote the distortion at 60 mV level and signal-to-noise and distortion are certainly good at this level, comparable with Mullard's for distortion anyway. The circuit will produce a relatively undistorted output up to about 2.5V rms into open circuit; thereafter the top of each waveform resembles a sawtooth and severe clipping occurs at 6V rms as one might expect. Into a 4.7k ohms load, the distortion began at 1V rms and clipped at a correspondingly lower level. This is essentially a low-level signal amplifier.

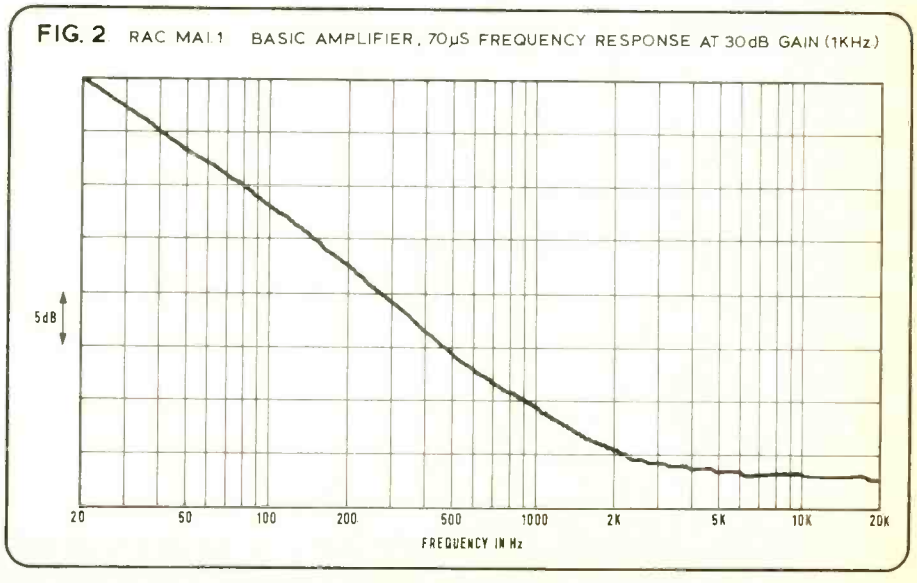
TI.1 tone control (2.25)

The *TI.1* is a tone control unit constructed on the same sized board as the others but using a Belling Lee 12-way connector in place of the eight-way connector used with the others; this is to accommodate the tone control connections (other units in the *T* range, not sent for review, will provide presence bumps or notches at particular frequencies, which may be ordered if non-standard).

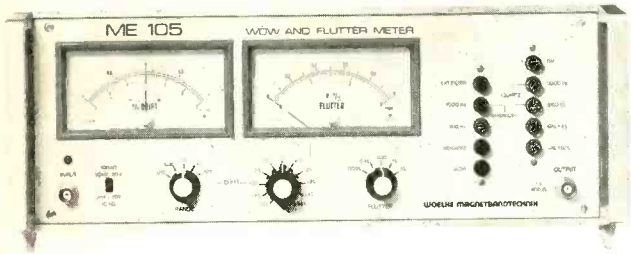
64 ▶







WOW and FLUTTER METERS



Illustrated is the ME 105, the very latest type of Wow and Flutter Meters manufactured by Woelke Magnetbandtechnik, Munich, Germany, and distributed exclusively by us in the U.K. Anyone concerned with the most accurate measurement of drift (down to plus/minus 0.1%) and wow and flutter (down to plus/minus 0.03%) will be interested in the ME 105, available from April onwards. Fuller, final details on application.

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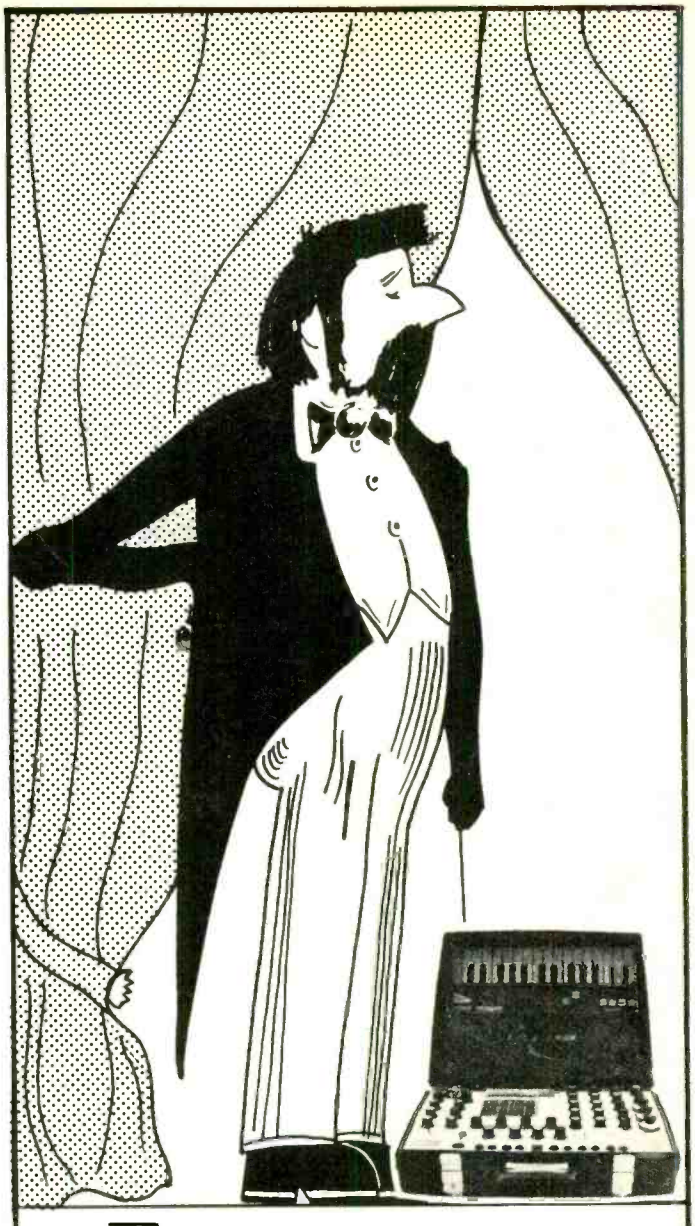

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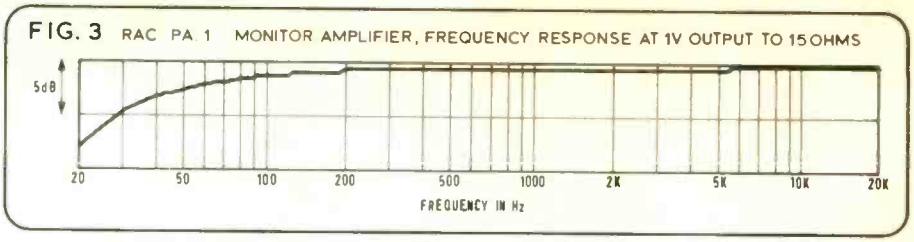


FIG. 3 RAC PA 1 MONITOR AMPLIFIER, FREQUENCY RESPONSE AT 1V OUTPUT TO 15 OHMS

Once again, a Mullard circuit, and performing very closely to Mullard published figures. Treble and bass control of about ±20 dB are claimed and achieved. The swing is about ±16 dB at 100 Hz and 10 kHz. Gain is just less than unity and the circuit uses a single transistor. Unfortunately it is inevitable with this kind of circuit that, unless the controls are flat or set to cut, the reduction in feedback available makes the distortion levels rather high, particularly intermodulation distortion. However, as many people also find, the performance of this kind of circuit is acceptable if the input level is kept down. With no load, an output approaching 4V rms was possible without clipping and with controls set flat; signal levels should normally be kept to about 250 mV. Input impedance is about 40k ohms and output impedance about 200 ohms.

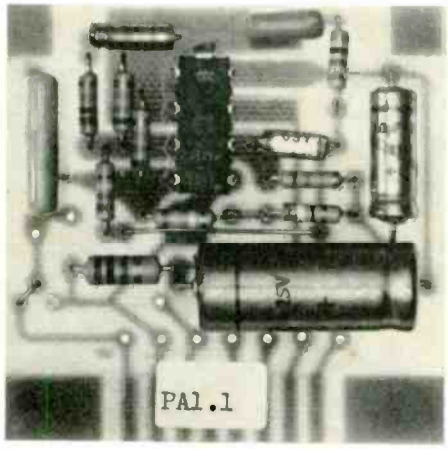
Although the circuit draws over 2 mA, the noise level is not troublesome, due presumably to the use of the *BC149* in place of the *148* in Mullard's circuit.

PA1.1 monitor amplifier (£5.50 basic)

The *PA1.1* is a nominal 3W (originally specified as 2W) monitor amplifier. It is based directly on the test circuit published by General Electric for their *GE PA237*. Now according to my literature, GE rate that ic at 2W in this circuit and show the distortion rising very sharply over that level. I wonder whether the original rating for the *PA.1* was not more realistic? I found that the output clipped at just over 5.5V rms with a 15 ohm load, which would rate the amplifier at about 2W. Perhaps it was an early sample. Or maybe RAC have now changed the ic without changing the literature.

The amplifier requires a heavy duty power supply (the *PI.1* is not adequate) and, in the absence of anything better, may be run off a raw 18V supply as given by a fast-charge battery charger with 1,000 µF across the output. With the 18V supply, output is limited to about 4.2V rms above 200 Hz and rather less below. A glance at the **fig. 3** response curve shows why. The bass rolls off and this is due almost entirely to the relatively small (250 µF) output coupling capacitor. Things can be improved with the addition of a 1,000 µF capacitor, at the expense of bulk. A pity, because the unit is neat, the same size as the other modules.

The first thing that strikes one about the amplifier is the noise. It is fairly tolerant of supply ripple until near the overload point; provided the input lead is terminated with a lowish impedance, hum is acceptably low even with the battery charger arrangement. But the hiss . . . I'm afraid that would rule it right out



for me. There are quieter discrete component modules of better performance around at this price.

I don't feel that this particular module is on, as a loudspeaker monitor amplifier anyway. If the noise were consistently better, it would make a useful headphone amplifier. Otherwise the only immediate use I see for it is as a VU meter drive (for which cheaper alternative modules are available—the *MA1.3* or *MA1.5*) or to drive a bridge rectifier and small series resistor to charge a capacitor that discharges through a larger resistor and meter—a simplified ppm. I shall be experimenting along those lines.

I should in fairness add, in spite of the alarming level of distortion revealed by the GE data sheets and the rather high harmonic distortion figure claimed for the module, that music sounded remarkably good through the amplifier at low levels. Even boys' singing voices, which are normally gritted up by a really bad amplifier, were quite acceptable on a short listening test through a medium-fi speaker, and organ music at low levels showed up no nasties.

Conclusions

The monitor amplifier apart, the RAC modules appear to be a useful and comprehensive range for anyone without the resources to buy from one of the top names. Presumably this comment would also be true of mixers built by RAC from these modules. They are in what used to be called the semi-professional class, before even the 'professional' tag was devalued by the chromed-plastic brigade. The power supply unit may not be adequate for an elaborate setup but no doubt RAC have their own solution for custom mixers and would oblige.

The circuitry is conservative and simple, perhaps a little disappointing. Clearly there are better units available, at a price, and they should perform better—particularly as regards noise and overloading. I think anyone considering adopting this approach to building a mixer would do well to obtain the Mullard publication as well as the RAC list of modules and accessories available, so that they are aware in advance of what sort of thing they are buying, how it is likely to perform, and what facilities are available. **John Fisher**

Classified Advertisements

Advertisements for this section must be pre-paid. The rate is **7p** per word, minimum **70p.** Box Nos. **20p** extra. Semi-display rates on application. Copy and remittance for advertisements in **JULY 1973** issue must reach these offices by **16th MAY 1973** addressed to: The Advertisement Manager, **Studio Sound,** Link House, Dingwall Avenue, Croydon CR9 2TA.

NOTE: Advertisement copy must be clearly printed in block capitals or typewritten.

Replies to Box Nos. should be addressed to the Advertisement Manager, Studio Sound, Link House, Dingwall Avenue, Croydon CR9 2TA, and the Box No. quoted on the outside of the envelope. The district after Box No. indicates its locality.

APPOINTMENTS VACANT

★**Wanted: freelance** sound recordist for recording and/or maintenance work in a small studio. Details to Box No. 654. (London area)

SOUND ENGINEER

Experienced man with high standards required in the public address and sound recording field, capable of organising and operating temporary P.A. systems covering conferences etc.—knowledge of electronics, tape editing and recording desirable. Smart appearance essential—reliable driver—salary negotiable.

Full written details to: **Managing Director, Griffiths Hansen (Recordings) Ltd., 12 Balderton Street, London W1Y 1TF**

★**Recording engineer required** (age 25-35) for small, established studios in W.1. Must be fully experienced in editing, dubbing and recording with multi-track machines. Background knowledge of electronics highly desirable. Please reply to Box No. 655.

AUDIO ENGINEER

required to maintain professional equipment. Experience in the field of Studio and/or Domestic Sound essential. Current driving licence an advantage. Please write giving full details to

Feldon Audio Ltd., 126 Gt. Portland Street, London W1N 5PH. Attention W. Dyer.

★**The London Film School** requires an instructor in the sound department. He should be familiar with Nagra recorders, film recording technique, and tape editing. Knowledge of the construction and maintenance of transistor amplifiers would be an advantage. Phone Bill Bland at 240 0168 for an appointment.

SITUATIONS VACANT

TECHNICIAN TRAINEE

Intelligent young man 16-18 years old offered opportunity to train ultimately as a public address and sound recording engineer. Must be of smart appearance and live with parents in Central London area.

Write for interview to:

MANAGING DIRECTOR
Griffiths Hansen (Recordings) Ltd., 12 Balderton Street, London W1Y 1TF

STUDIO FACILITIES

★**County Recording Service.** Stereo and Mono masters, 12″ vinyl pressings.

YOUR TAPES TO DISC

Records made to order—7″ from £1.50, 12″ from £4.00. 4-day postal service. Vinyl pressings, sleeves, labels. Tax-free for schools, etc. We cut records for many Recording Studios, etc, and use the same equipment for you: NEUMANN Disc Cutting Lathes—Mono and Stereo systems. Professional tape machines with Ferrite playback heads, Dolby A and B systems, 200W Amplifiers, Lockwood monitors, Teletronix/Ortofon Limiters. Send SAE for photo leaflet.

DEROY STUDIOS (1948)
Hawk Street, CARNFORTH, Lancs. Tel. 2273

★**County Recording Service.** 7″ vinyl discs pressed on our own plant.

★**Fanfare Records.** Tape - disc pressings, demo's, masters, any quantity. Studio/mobile. Neumann disc cutter. S.A.E. brochure. 1 Broomfield Close, Rydes Hill, Guildford. Telephone 0483 61684.

COMPACT CASSETTES
PROFESSIONAL HIGH-SPEED DUPLICATION

Dolby B—compression and equalisation available—competitive prices on small runs—full productions undertaken—music and language specialists.

Contact Chris Sands
AUDIO EDUCATION COMPANY
01-723 6635

★**County Recording Service.** Stereo and Mono discs from your tape.

★**Graham Clark Records.** Tape to disc pressings. 124A Station Road, Addlestone, Weybridge, Surrey. Tel. Weybridge 43367.

Roger Squire
DJ Studios

The best facilities in town for making Audition Tapes, Jingles, Programmes and Sound Commercials. For further information telephone

01-722 8111

★**J & B Recordings.** Tape to disc—latest high level disc cutting, all speeds. Mastering pressings, studio, mobile. 14 Willows Avenue, Morden, Surrey. MITcham 9952.

mjb **recording and transcription service**

Vinyl pressings and acetate demodiscs. Limiting, compression and equalisation facilities; high undistorted cutting levels with feedback cutter heads. Booklet available.

ST. MICHAEL'S, SHINFIELD ROAD, SHINFIELD GREEN, READING, BERKS.
Reading (0734) 84487 Member A.P.R.S.

★**County Recording Service.** Top quality, reasonable price, quick delivery. Tel. Bracknell 4935. London Road, Binfield, Bracknell, Berks. RG12 5BS.

★**Mobile recording** van. Live sessions. Stereo. Anywhere. Mobitrack, 01-892 9599.

FOR SALE—TRADE

The PEAK PROGRAM METER was developed in 1936 by the BBC for monitoring modulation depths at transmitters.

Now to BS 4297, it remains the most sensible way of metering audio and avoiding distortion
Drive circuit for 1mA L.H. zero meters

C.W.O. further 5% less.	2 off	4 off	10 off
Complete kit	£8·00	£7·60	£7·20	£6·80
Built & aligned	£12·00	£11·40	£10·80	£10·20

Ernest Turner PPM meter., scaled -22 to +4 OR 1 to 7 Type 642, 71 x 56mm **£9·00**, Type 643, 102 x 79mm **£10·70.**

SURREY ELECTRONICS
24 High Street, Merstham, Surrey.

★**Nagra IVL** Neo-Pilotton model pre-amps for Sennheiser mics £560. Crystal pack £68. Future Film Developments, 90 Wardour Street, London W1V 3LE.

★**West-End Studio** recently reorganised has for sale sundry studio equipment, including amplifiers, speakers, etc. Please send for list. Please reply to Box No. 656.

UNIMIXER STUDIO 4 and 6 MIXERS

Each channel can be switched to accept 5 different inputs, choice of DIN, Cannon, jack-sockets, slider faders, tone controls, PPM. Overall noise is better than —127 dBv with a 200 ohm source (using 20 kHz band with filter). Mains or battery powered. Prices from £87 (as with the successful 4S range, supplied directly to users) only from:

SOUNDEX LTD
18 Blenheim Road, London W4 1ES 01-995 1661

★**Professional tape** only 45p. 1200ft Agfa on hubs, no joins (p. and p. one box 25p, each additional box 10p). We handle 99% of all s/h professional recording equipment. Send for list. Jackson Studios, Rickmansworth, Herts.

★**Tame those dB's . . .** Plug in professional quality FET compressor module £15.50. For the 'slick operator' . . . 'Voice over' module £15.50. S.A.E. details. Cathedral Sound SS, "Fourways", Morris Lane, Halsall, Lancs. L39 8SX.

RAC MIXERS
WE HAVE MOVED!

Demand for our products has meant larger premises! Our new address:

19 Freemantle Road, Bilton, Rugby
Tel: 0788-810877

Custom Built RAC Mixers for Groups, PA, Hospital Broadcasting, Recording, Discos, etc

RAC Audio Modules for building your own mixers. Shure, AKG, Calrec Mikes, Stands, etc in stock. Write, phone or visit us.

★**Lancashire.** Tandberg, Ferrograph, Tape Recorders, etc. Plus over 10,000 high fidelity systems. After-sales service. Holdings, Photo-Audio Centre, 39-41 Mincing Lane, Blackburn BBA 2AF. Tel. 59595/6.

★**If quality matters** consult first our 105-page illustrated Hi-fi catalogue with technical specifications (60p). Members enjoy unbiased advisory service. preferential terms. Membership (40p) p.a. Our associates also manufacture records from your own tapes or record the Master at our studios (Steinway Grand). Bulk terms for choirs, fund-raising, slim discs. Please specify requirements. Audio Supply Association, 18 Blenheim Road, London, W.4. Tel. 01-995 1661.

★ **16 channel, 8 group** output Cadac Console. Full equalisation on each channel. 2 foldback systems. 3 Echo systems. 3 Pye compressors. Comprehensive patchbay for greatest versatility. £2,900. Telephone 01-622 1228.

FOR SALE—PRIVATE

★**Rogers Ravensbrook Amplifier,** in teak case. Excellent condition. Demonstration arranged if required. Buyer collects. £30.00. Phone 0276 (Bagshot) 72897.

TAPE EXCHANGES

★**Now available** to non-members: "Hints for Tapetalkers—International Message Making". Helpful 32-page booklet 15p. Worldwide Tapetalk, 35 The Gardens, Harrow.

WANTED

★**Mobile recording vehicle** with or without equipment is required by the Music Department, University of Surrey, Guildford, Surrey. Details please to John Borwick, telephone Guildford 71281.

★**Lee Electronics.** The Tape Recorder and Hi-Fi Specialists wish to purchase good quality Tape and Hi-Fi equipment for cash. 400 Edgware Road, W.2. Phone PAD 5521.

PATENT

BRITISH PATENT No. 1184823. METHOD OF PRODUCING MULTI-TRACK, SINGLE OR MULTI-GAP, FERRITIC MAGNETIC REPRODUCING AND RECORDING HEADS. Owner desires commercial exploitation on reasonable terms by licence or sale.

Enquiries:

FITZPATRICKS,
Chartered Patent Agents, 14-18 Cadogan Street, Glasgow G2 6QW and Warwick House, Warwick Court, London WC1R 5DJ

MISCELLANEOUS

★**Tape and Cassette Recorder Repairs** by Specialists. The Tape Recorder Centre, 82 High Holborn, London W.C.1

NATIONAL FILM SCHOOL

ADDITIONAL COURSE FOR FILM SOUND RECORDISTS

An additional course in film sound recording, to include the training of sound recordists, studio mixers and dubbing mixers, is being considered at the School for October 1973. The course would last 3 years, starting with a general course in the first year and reaching professional standards in the third.
Those interested should write immediately to the Director.

National Film School
Beaconsfield Film Studios, Station Road
Beaconsfield, Bucks,

INDEX TO ADVERTISERS

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APRS 73

6th Annual

EXHIBITION OF PROFESSIONAL RECORDING EQUIPMENT LONDON

FRIDAY 22 JUNE
10.00—21.00 HRS

SATURDAY 23 JUNE
10.00—18.00 HRS

CONNAUGHT ROOMS GREAT QUEEN ST. LONDON
HOLBORN TUBE STATION

*AUDIX BB LTD
*ALLOTROPE LTD
ALLEN & HEATH LTD
ALICE (STANCOIL) LTD
*AGFA-GEVAERT LTD
*AMITY TAPE DEVELOPMENTS LTD
AMPEX (G.B.) LTD.
*AUDIO APPLICATIONS LTD
*AV DISTRIBUTORS (LONDON) LTD
*AUDIO DEVELOPMENTS LTD
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*BIAS ELECTRONICS LTD
BEAT INSTRUMENTAL
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*CADAC (LONDON) LTD
*CALREC AUDIO LTD
CETEC INC.
*CTH ELECTRONICS
*DOLBY LABORATORIES INC
ELECTRO-VOICE
EMI TAPE LTD
EVERSHED POWER-OPTICS LTD
*FUTURE FILM
*FRASER-PEACOCK ASSOCIATES
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*GRAMPIAN REPRODUCERS LTD
HELIOS ELECTRONICS
*HAYDEN LABORATORIES LTD
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APRS 73

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E. L. MASEK
23 CHESTNUT AVENUE
CHORLEYWOOD, HERTS.
ENGLAND

INDUSTRIAL TAPE APPLICATIONS LTD
JACKSON RECORDING CO LTD*
KLARK-TEKNIK LTD*
KEF ELECTRONICS LTD
LAMB LABORATORIES LTD
LENNARD DEVELOPMENTS LTD*
JACQUES LEVY*
Professional Recording Services
LIGHTING TECHNOLOGY LTD
LEEVERS-RICH EQUIPMENT LTD*
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MUSIC WEEK
MSR ELECTRONICS LTD*
KEITH MONKS (AUDIO) LTD
RUPERT NEVE & CO LTD*
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RUGBY AUTOMATION CONSULTANTS
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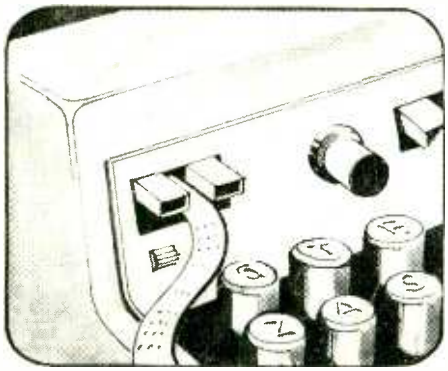
STUDIO SOUND
SHURE ELECTRONICS LTD*
TRIDENT AUDIO DEVELOPMENTS*
TAPE RECORDER DEVELOPMENTS LTD*
VITAVOX LTD*

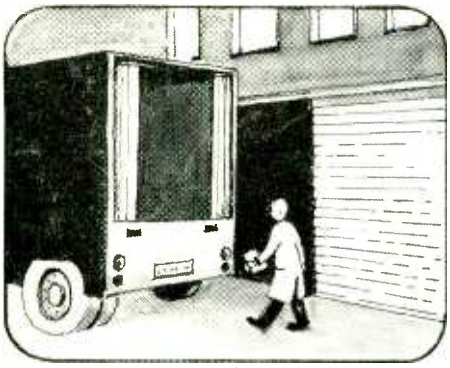
EXHIBITORS' List at time of going to press

*** APRS MEMBERS**

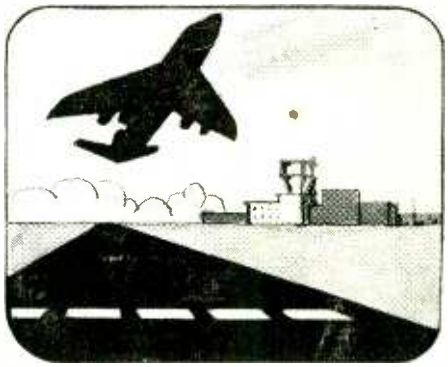
Neve Storyboard



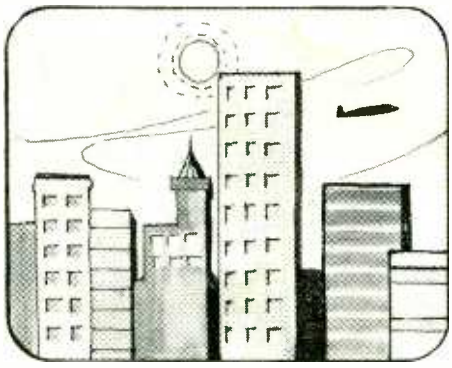
SFX: Telex machine.
Customer wishes to order 24 channel music recording console to be in Montreal by Monday.
Message received by Neve previous Tuesday .....



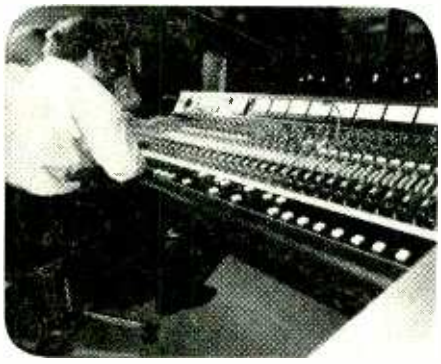
Neve S24/8/16 console delivered to U.K. packers Thursday.....



Delivered to London Airport Friday.



Arrives Montreal 1pm Saturday.



Powered up in studio fully tested 6 pm same afternoon .....

In use for live F/M broadcast 10.30pm Saturday (same evening).
MVO: 'Who said Monday?'

Neve

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Melbourn, Royston,
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cables Neve Cambridge

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